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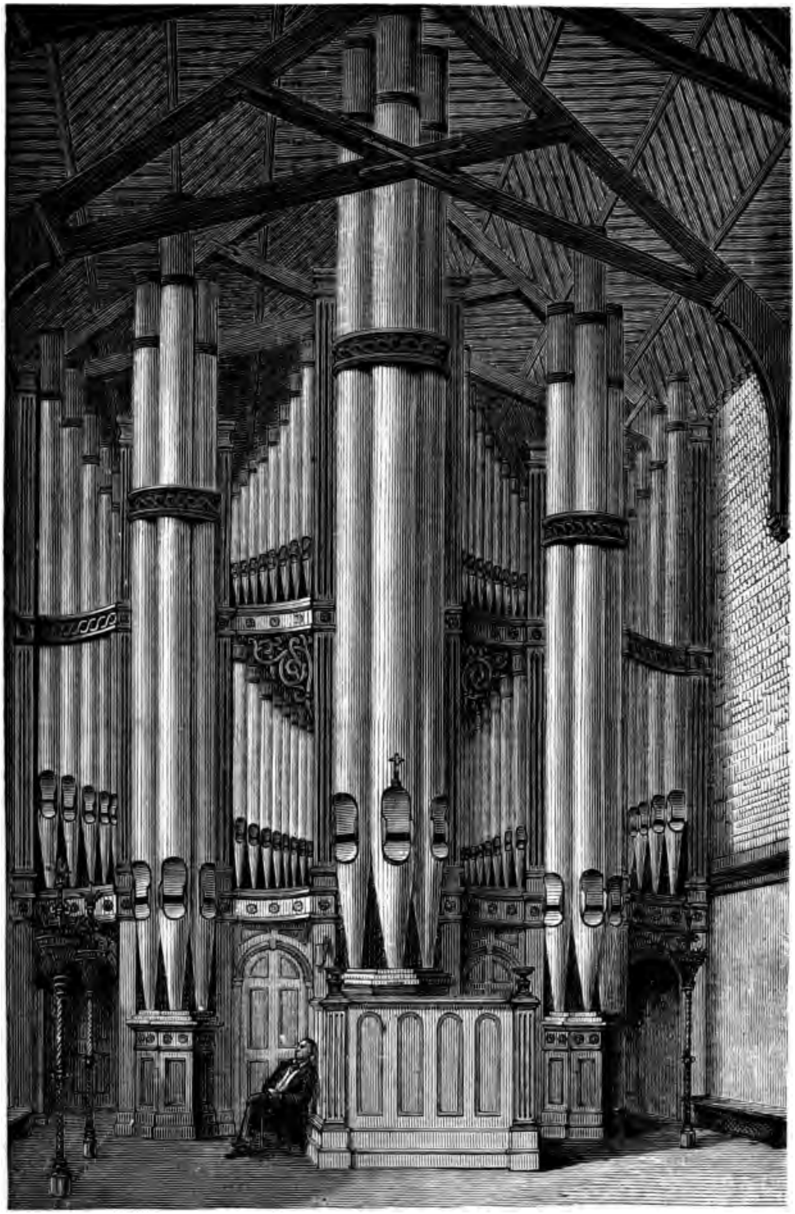
Organs

and Organ Building.

ORGANS AND ORGAN BUILDING.



MR. HOLMES' GREAT ORGAN, LONDON.

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Organs and Organ Building:

A

TREATISE ON THE HISTORY AND CONSTRUCTION
OF THE ORGAN,

FROM

ITS ORIGIN TO THE PRESENT DAY,

WITH

IMPORTANT SPECIFICATIONS.

ILLUSTRATED.

BY

C. A. EDWARDS.

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TO

THE REV. SIR F. A. GORE OUSELEY, BART., MUS. DOC., ETC.,

THIS WORK IS INSCRIBED BY THE AUTHOR,

IN ACKNOWLEDGEMENT OF MANY ACTS OF KINDNESS,

AND

AS A MARK OF SINCERE REGARD.

PREFACE.

ERRATA.

Page 26.—In Latin Inscription, for "Tertia" *read* "Tertii;" for "Clementissima" *read* "Clementissimi;" for "Augustissima" *read* "Augustissimi."

Page 238.—Under Clifton, Victoria Rooms, in footnote, for "drawn" *read* "drum."

literature the first contains far more than the hard worked country organist or the amateur have either the time or desire to attain, whereas those of the second are for the most part too shallow to afford the student any lasting benefit or satisfaction. It has, therefore, been the endeavour of the author in this case to pursue a middle course, that may be useful alike to those who desire to study the subject with care, as also to the many who have only time to master the outlines of organ building.

The historical portion of the work has been compiled with a view to brevity as well as completeness, and it is hoped that it may be found

PREFACE.

THE works that have hitherto appeared on the Organ can, for the most part, be divided into two distinct classes—the first including those which may be termed text books, and which embrace every detail of construction and afford the minutest description of each portion of the instrument, together with a history comprising almost every recorded fact on the subject. Among the second class would appear, with one or two exceptions, a multitude of mere pamphlets, containing a brief outline of an ordinary instrument, and leaving the student or amateur very much as he started with regard to actual knowledge. These latter, too, have frequently been compiled by persons interested in certain instruments or building firms, and have had a tail of very limited general information hung on to what is at best but a more or less cleverly disguised advertisement. Of these two divisions in organ literature the first contains far more than the hard worked country organist or the amateur have either the time or desire to attain, whereas those of the second are for the most part too shallow to afford the student any lasting benefit or satisfaction. It has, therefore, been the endeavour of the author in this case to pursue a middle course, that may be useful alike to those who desire to study the subject with care, as also to the many who have only time to master the outlines of organ building.

The historical portion of the work has been compiled with a view to brevity as well as completeness, and it is hoped that it may be found to contain all the more important facts relating to the early history of the organ, and give typical illustrations of the gradual progress towards its present status.

The practical division of the book has been written as succinctly as the conditions will allow: enough has been said under each heading to furnish a clear understanding of the principles involved in the usual modes of construction. The endeavour has been made to give a thorough insight into practical building, without undue prolixity in minor detail.

The Author cannot close this preface without alluding to the important help he received at the hands of the late Sir Thomas Duffus Hardy, who placed his researches on the Utrecht Psalter at his command, and also the courteous assistance rendered by the late the Hon. and Very Reverend Augustus Duncombe, D.D., Dean of York, who permitted him to take valuable notes from the archives of The Minster. At the same time he would thank the Rev. Sir F. A. Gore Ouseley, Bart., for the kind manner in which he allowed the Author access to his unique library; also Dr. Longhurst, of Canterbury, Mr. Wood, of Exeter, and that great number of organists throughout the kingdom who so promptly handed in specifications of their instruments, and in many cases entered into the spirit of the work and rendered valuable aid. The opening chapters of the constructive portion of the work were very kindly revised by Messrs. Bryceson Brothers, from whom also many useful hints have been received.

Bourne House,
Wiveliscombe,
November 23, 1880.

PART I.

HISTORY.

CHAPTER I.

Origin and Early History.

THERE is probably no instrument which has from time to time so engrossed the thoughts of musicians, as also of the public at large, as the organ, combining, as it does in its completeness the effects of almost all important instruments, and capable of an expression to be obtained from none other; ranging in tone from the most boisterous *forte* to the most delicate *pianissimo,* it alone stands forth as the only adequate representative of the orchestra, the which in some respects it even surpasses. Thus has it earned the title of the "King of Instruments." In the same way that the pianoforte traces its origin from the most primitive lyre of the Egyptians, so does this noble work of art by gradual, though well-marked stages, become a mere row of reed pipes, tied under the chin of an idle shepherd. In the following pages it will be our object to place before the reader the development of the organ from its primary sources, giving a brief sketch of its history down to the present day, and to show clearly and practically the principles upon which the modern organ is built, together with short incidental notices of the older builders who have in our better instruments left lasting monuments of their fame.

The actual origin of the organ will ever remain in obscurity, though there can be no doubt that the first attempt at the production of sounds from pipes can be discerned in the Pandean pipes, which consisted of a row of reeds bound firmly together, and played by means of the breath being forced into them. The mythical god, Pan, has the honour of this invention ascribed to him.* But without treading the uncertain paths of myth, we find the Grecian and Latin shepherds frequently amused themselves by means of the reed pipes culled from the neighbouring brook. The next step to be noticed was the introduction of a box, the primitive wind-chest, to which the breath was introduced by a single pipe, representing the wind trunk, and into which box the sounding pipes were fixed. Under these circumstances it will be seen that all the pipes would speak at once, which inconvenience was obviated by placing the fingers over those not required. The great drawback to the instrument being the difficulty of stopping the requisite number of pipes, we are not surprised at soon finding that valves were placed under each pipe, so that, on pressing a given valve, a certain one would speak, by which arrangement it became obvious that the number of pipes might be increased indefinitely, the which being gradually accomplished, the difficulty of wind supply became apparent, and, as a substitute for the lung, we find a rude kind of skin bag being used, and an instrument which strongly resembled the bagpipes (Capa), and in principle was precisely similar to the modern organ, pipes, wind chest, wind trunk, and bellows, being more or less complete, was the result. The accompanying cut (Fig. 1) represents one of the earliest drawings of an instrument of this nature, and is a copy of a manuscript of the thirteenth century ("Les Arts du Moyen Age"). It is, perhaps, advisable to point out that although we trace this instrument clearly to the Greeks, and that we derive our name from their tongue, that the original term, *ὄργὰνον*, was employed not only for this but for all musical instruments ("St. Augustine's Commentary on the 4th verse of the 150th Psalm"), as the Romans afterwards employed the word *organum* to many machines of a complicated nature, especially to stringed musical instruments.

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* Pan primus calamos cerâ conjungere plures (Virg. Buc. Ec. II., 32).

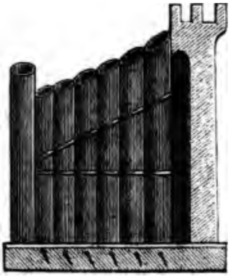

FIG. 1.

All the ingenuity of those engaged in producing what for the future we may dignify with the title organs, was now centered in obtaining a steady and sufficient supply of wind. It being found that men could not regulate the amount of wind supplied by their efforts, and that therefore the tone varied greatly, the power of water was called into play, and the hydraulic organ, or hydraulicon, sprung into existence. The manner in which the ancients applied this power seems to have been most complicated for such small results, and has never been satisfactorily explained. Archimedes has had the credit of advancing the hydraulicon, and it will be curious to notice that the water used to act on the instrument was first pumped by manual labour, and seems only to have performed the part of steadying and regulating the supply of wind, and not actually producing it. These instruments soon became common throughout Italy, and the manufacture at this period was confined to the Greeks and Romans. In the year A.D. 395 Theodosius possessed an instrument which he has the credit of having made. In the fourth century also the Emperor Julian wrote on the subject ("Anthologia," Book I., chap. 86). Vitruvius, the architect, describes an organ in his tenth book. St. Jerom, in his writings, mentions one which might be heard a thousand paces or a mile; he also speaks of another at Jerusalem, which could be heard at the Mount of Olives. But by far the most important matter to chronicle about this period is the introduction of organs into the church, which at once lifted them from obscurity, and brought them prominently before the world at large. The credit of this step is accorded by Bellarmine, who quotes Platina's statements from the Pontifical, to Pope Vitalian, about A.D. 660, and, as an immediate consequence of this encouragement, organs began to be sought and scattered throughout Europe. Pepin the Short, King of France, desired to obtain one, and having applied to the Emperor Constantine (Compronymus), that potentate sent him, by special embassy, an instrument, the pipes of which were made of lead. In the year A.D. 826 a Venetian, named Gregorius, built an organ for Louis I., King of France, at Aix-la-Chapelle. Some authorities state that this instrument was not blown by water, and was, therefore, a "pneumatic" organ, though, as other writers distinctly mention it as an hydraulic organ, it is better to infer that it was no exception to the usual kind then made. It must be noticed that hitherto organs were imported into Europe from Italy, but as they became more common and more sought, the French took up the art, and in a short time not only equalled, but excelled their former rivals in such a manner as to establish the manufacture of organs in their country as a recognised branch of enterprise, and as the civilisation of the Greeks and Romans waned, and that of the Franks rose, organ building, together with the other arts, throve, and, spreading throughout Germany, took such a firm hold that up to even a recent period it was to that quarter that the finest instruments in existence owed their being.

There are two representations of the organ occurring in the Utrecht Psalter that have been the subject of great controversy among antiquarians. That document has been ascribed by some of the most able authorities to the sixth, or even the fifth, century; others being of opinion that these very organs themselves, if not added after the MS. was completed, prove it of the ninth or tenth century. The larger drawing, of which Fig. 2 is an accurate copy, appears over the 150th Psalm, and the smaller (Fig. 3) over the 151st Psalm. Paul Lacroix has a cut of the former in his "Arts du Moyen Age," and attributes it to the later date; but this is probably owing to the fact that he copied it from the celebrated "Eadwine," or "Canterbury Psalter," in the library of Trinity College, Cambridge, written in the eleventh century, and well

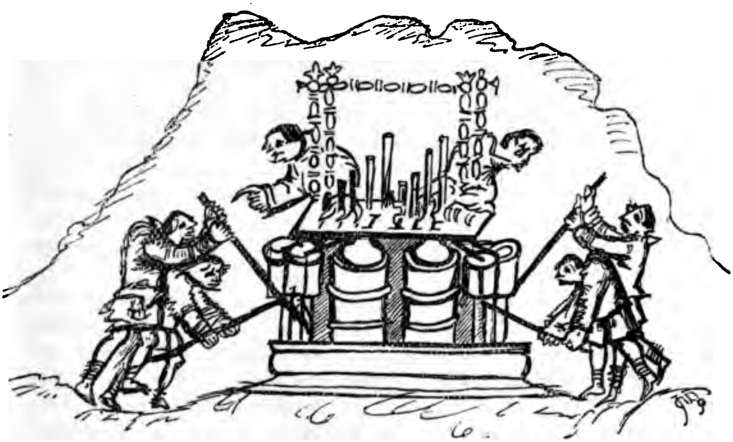

FIG. 2.

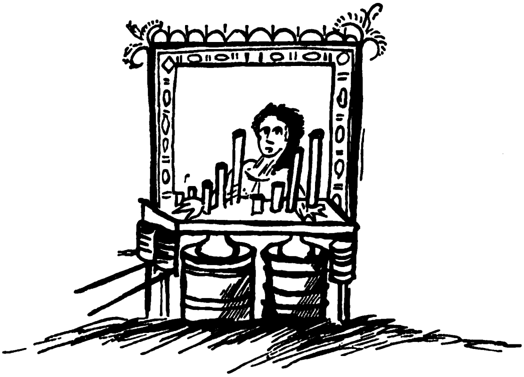

FIG. 3.

known to be only a copy of the Utrecht MS., which was written at least five centuries earlier. The drawing in the "Eadwine Psalter" is not a very accurate copy.

The organ was first introduced into this country by Aldhelm, Bishop of Shireburn, in the seventh century. He describes it in some of his writings as "a mightly instrument with innumerable tones, blown with bellows, and enclosed in a gilded case."

In the reign of Edgar, St. Dunstan gave an organ to Malmsbury Abbey, which was described by the celebrated William of Malmsbury: "The wind, being forced out by the violence of the *hot* water, fills the whole cavity of the instrument, which, from several appertures, passing through *brass* pipes, sends forth musical noises." It will be noticed that the water is mentioned as being hot, which is probably not an error, as has by some authorities been supposed, inasmuch as that Dom Bedos, a Benedictine monk, in a celebrated work, "L'Art du Facteur des Orgues," mentions that the same William of Malmsbury, in describing an organ at Rheims still extant (A.D. 1125), says, that "the air escaping in a surprising manner, by the force of *hot* water, fills the instrument," &c. This has been urged as a possible instance of the use of steam, though there seems little or no reason that such was the case. St. Dunstan also gave an organ to Glastonbury Abbey, similar to the one at Malmsbury. Earl Ethelwin, the founder of Ramsay Abbey, A.D. 974, gave the sum of £30 to provide *copper* pipes for the organ of the abbey church.

Elfeg, Bishop of Winchester, obtained for his cathedral the largest organ then known (A.D. 951). This was described by the monk Wolstan in the tenth century; and Mason, the poet, in his essay on "Instrumental Church Music," gives the following translation:—

> **Twelve pairs of bellows, ranged in stated row,**
> **Are joined about, and fourteen more below.**
> **These the full force of seventy men require,**
> **Who ceaseless toil and plenteously perspire;**
> **Each aiding each, till all the wind be pressed**
> **In the close confines of th' incumbent chest,**
> **On which four hundred pipes in order rise**
> **To bellow forth the blast the chest supplies.**

The organ thus described could not have been of so great a magnitude as the poem would lead us to believe. The clavier or keyboard was then unknown, and each note was commanded by means of a distinct lever—the compass could not have been more than ten notes, including one semitone (the lyric), which probably took the position of our B flat. Each note would thus have had forty pipes, and as there is no reason to believe that any form of register or stop was known, it is obvious that the organ was always at its full power. Whether the "seventy men" were employed at the same time to blow the bellows, or whether they came on in sets, is a question, though the latter is by far the more probable.

At the close of the tenth century organs became general, not only in cathedral churches, but also in monastic establishments. Throughout Germany they were coming into general use, and many churches contained what were then large instruments, such as those at Haberstadt, Erfurt, &c. The monk Theophilus wrote a work on "Divers Arts" at the beginning of the eleventh century, in which he makes frequent mention of organs, and devotes much space to their description and mode of manufacture.

At the close of the eleventh century one of the great steps in organ building took place, which marked the advent of an instrument which differed in no material manner from those now in use. At Magdeburg, in Saxony, was erected an organ, having a keyboard or clavier of two octaves. These keys were several inches wide, and were pressed down one at a time, and required no little weight to bring them into action, hence the old name of "organ beater," which was the original professional title of the performer. Taking into consideration the fact that at this period the organ was used merely as a guide for singing, and only rarely if ever as a solo instrument, it will be seen that after all this rough keyboard answered the requirements of the age. It does not appear at what date the semitones were introduced, though all the pictures of clavier organs possess them. The woodcut (Fig. 4) shows a "simple clavier organ of the fourteenth century—" the one priest blowing two pairs of bellows while the other "beats" the clavier; it will be most interesting to note the distribution of pipes, so like that of the smaller organs of the present day. The

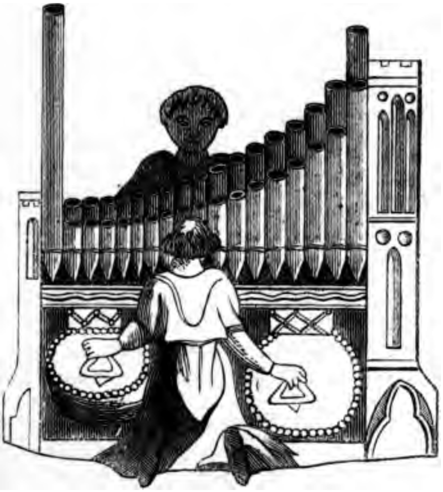

FIG. 4.

shape of the key at this period was not square or oblong, but rounded at the outer end, with a contracted neck (Fig 5). And now the old difficulty arose about wind power, and as organs increased in size so did the necessity for increasing the amount and steady supply of the wind become felt. As was seen in the description of the Winchester organ, many bellows and seventy men were required to supply what would now be looked upon as a village instrument. In some organs men stood on the various bellows alternately, and by their weight thus kept up a constant supply; the bellows were sometimes placed above the pipes, and were "horizontal."

The organ had no sooner become general in churches and cathedrals than some of the churchwardens of that day deemed their use during divine service scandalous and wicked; and in the thirteenth century we find that the priests of Rome and Greece expelled the organ from their service, that their worship might, by its simplicity, contrast with that of the Jews and Pagans*—it will be noticed that in the Greek Church it has never been re-introduced. This little opposition was the very impulse that was required to further the art. Controversy produced notoriety, and we find the organ at last asserting itself in such a manner that in a few years every monastery possessed a small instrument, termed a "Regal," to lead the voices, and from this period the organ has steadily progressed, and is still making gigantic strides to perfection.

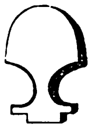
FIG. 5.

About this time was introduced a characteristic which has since distinguished the organ from all other instruments, and given to it a character at once unique—we allude to the so-called mutation stops, mixtures, twelfths, &c. At the proper place we shall explain the *modus operandi* of these, with regard to their relations, &c., with the groundwork and other stops; here we only need mention that combinations of pipes tuned to thirds, fifths, and tenths of the fundamental notes were used, and were found to add peculiar brilliancy to the effect of unison singing. The reason for this will be given under the chapter treating on mutation stops. Registers or stops being unknown, it will be seen that the organ, being thus tuned, was a fixed mixture, and always produced the chord to which the pipes were tuned. The oldest mixture spoken of was $\overset{12}{\underset{5}{8}}$ in relation to the fundamental. There are others containing the third mentioned. We would point out that in all probability there were many pipes to each key, tuned to the fundamental, and perhaps only one to the twelfth, octave, and fifth severally, so that the mixture effect was not necessarilly so overpowering as might at first be imagined. This is said by some to have been the origin of harmony, though it appears merely a supposition for which there is little foundation. There is another most interesting origin ascribed to the use of the *quint*. It is said that one of the earlier Popes, finding the unison singing of a choir of monks was peculiarly heavy, ordered a number of boys to sing the melody a fifth higher. This was found to brighten the general effect without in any way clashing, and is said to have originated the idea of the *quint* and *twelfth*, which will bye and bye be shown to be mathematically correct, and even necessary adjuncts to the organ.

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* Pierce's Vindication of the Disenters. Ed. 1718, p. 395.

Having now traced the history of the instrument to the time when it nearly resembles those at present in use, we shall next proceed to mention some of the earlier celebrities who devoted their energies to the construction of the instrument.

* * *

CHAPTER II.

1250 TO 1650.

Early Lay Builders—William Wotton—John Loosemore—Robert Dallam, &c.

As we said in the previous chapter, "Regals" became common in monastic churches throughout England. The above term was derived from the Italian *Rigabello.* The name "Portatives," from the Latin *porto,* I carry, was also given to these instruments, on account of the ease with which they were moved from place to place, and, as some authorities have it, were borne in religious processions. There is a point of interest attached to this name, viz., that it stands in contrast to the "Posativ," or immovable instrument, of a more solid construction, and which has been handed down to us in the form of our "choir" organ. Regals were in use up to a late period on the Continent, and were common up to the reign of Henry VIII., and even Elizabeth, in this country. The "Posativ" organ had a full set of keys, was played with both hands, and was frequently placed by the side or in frônt of a larger instrument in a church; it was made of small-scale pipes, and used for accompanying the voice; the clavier was often behind the performer as he sat at the larger instrument. A good instance of its position may be seen in the present organ of St. Paul's Cathedral, where the performer sits with his back to what represents an old "chayre," or "chaire" organ, that name being an evident corruption of "choir" organ, and accounted for by the fact that the player had to change his seat in order to perform on the smaller instrument.

It has been observed that in many old records of about this period organs were spoken of as if in pairs. This expression has been a great bone of contention with authorities, as they never could agree as to what plurality it referred. Some asserted that allusion was made to the number of keyboards, others that it meant "an organ with two stops;" but it seems that in all cases where there were more that one clavier the expression "double organ" was used, and it would appear that the word "payre" alluded to no special duplexity, but was used merely to express a sense of compound action, perhaps as regards the pipes.

The keyboard now began to assume the shape which it still retains, the monks, to whom we owe so much for having fostered the arts during the dark ages, having decreased the size of the keys, and the depth to which they descended, so that the finger alone was sufficient to bring them into action. They also increased the compass both upwards and downwards to about three octaves in all. The semitones, too, were now invariably found in their places; they are said to have first been used in Venice, though the name of the actual builder who made them general is not known. It is believed that the great organ at Haberstadt, built by Faber, a priest, A.D. 1361, was the first which possessed the semitones complete. The size of the pipes of this instrument is of great interest, it having been stated that the compass was from B in the bass to A in the treble cleff, and that the B pipe *was 32ft. long and under 4in. in diameter*, under which circumstances it would appear that it did not speak the note natural to so long a tube, but probably the octave.

The pedals were also introduced at about this period; some say by a German named Bernhard, who was organist to the Doge of Venice (A. D. 1470-80); but it seems that they were used anterior to this, and Drossdorf, of Mayence, undoubtedly built an organ A.D. 1444 with pedals, the probability being that it was Bernhard who brought them into general use, and thus obtained notoriety as their inventor. As we have seen, two keyboards had already appeared in one instrument, and given rise to the term "double organ," mentioned above, and this arrangement suggested the use of the "copula," or "coupler," which is still, and ever will be, of great use to the organist. Messrs. Hopkins and Rimbault, in their text-book, have mentioned and quoted at length many curious records relating to the construction of instruments during the fifteenth and sixteenth centuries, and it may be observed from these that it was the custom in all agreements to mention most minutely the various parts of the organ to be constructed, and it was also usual for the builder to go to the place where the instrument was to be set up, and do his work on the spot. Up to about the middle of the fifteenth century the art of organ building appears to have been entirely confined to the clergy, inasmuch as there is no mention of any layman who was a builder by profession. In fact it is clear that the organs of this period were constructed under the supervision of some monk, who performed all the more difficult operations of voicing the pipes, &c., but directed carpenters and labourers how and in what manner to put the various parts of an instrument together.

So soon as organs were in such request as to assume importance as articles of commerce, their construction began to find favour in the eyes of the laity, and secular builders sprang up in accordance with the ever prominent law of demand and supply. Here, again, we must cite Germany as the home of the early lay builders, and the names of the great fathers of this art for many years are found to be German. Heinrick Traxdorf has the credit of being the first layman of the craft. Andre and Smid (the latter of whom must not be confounded with the Schmidt of later date) are other instances of early lay builders, but it is not necessary to enumerate more. In our own country William Wotton (A.D. 1489) was the earliest builder by profession, and was a native of Oxford, where he built an organ for Merton College, as also one for Magdalen Chapel. The names of Chamberlyn (1509), Perrott (1526), and White (1531), appear as having belonged to builders who repaired or altered Wotton's instrument at the dates given.

Towards the close of the sixteenth century, and the earlier part of the seventeenth, there is not much to attract attention. There are a great number of old papers mentioning organs of this period in almost all parts of the country, but they do not seem to have made any marked improvement. Robart was a local builder at Crewkerne, who deserves notice as having the credit of letting organs out by the year. This builder flourished about 1580-90.

The latter half of the seventeenth century is full of interest, some good work having been executed at this period, which yet remains in almost its pristine state.

In the year 1660 there were in England the following builders, of whom we have authentic record : Preston (York), Thamar (Peterborough), Haywood (Bath), Loosemore (Exeter), and Dallans, or Dallam (London). The two first we dismiss with merely stating that they were undoubted builders, though their works have not been authentically handed down to us. Of Haywood we would say that Mr. Hopkins assures us that his reputed work at Wimborne was first-rate. John Loosemore, born 1613, at Exeter, has become conspicuous among the older builders as having built a magnificent organ for the cathedral of his native city (1665), which, though altered at different periods, and since added to by Schreider, Jordan, Micheau, &c., nevertheless, up to a recent date, 1875, remained in the original handsome old case, bearing in a conspicuous place toward the choir of the cathedral, the legend, "JOHN LOOSEMORE MADE THIS ORGAN, 1665," and contained almost all the original work of its celebrated author. This instrument was placed on the screen, dividing the nave from the choir, had a double front, and was altogether an ornament to the building. It was specially notable on account of the double diapason, 20ft. in length, and this is still retained. The metal pipes were of tin, and, having been re-cast, still remain in the present instrument. There was a tower of pipes within the case which *had never been used* (1859), and this is of interest, inasmuch as the same thing occurs in an organ at Tiverton in the same county, built by Bernhard Schmidt (1696). The reason given is that the conveyancers would have such a distance to go, and would become too complicated. The Exeter organ has, as just stated, been frequently added to, and has lately been almost entirely rebuilt by Speechly, of London, and the old case has disappeared. It retains one peculiarity, viz., that in the claviers the naturals are black, and the raised notes white, reversing the usual order; this, we have been told, was a caprice of one of the past organists. Loosemore also built a small organ for the school in connection with the cathedral, and one which up to a recent period remained precisely as he left it for Sir George Trevelyan (1665). This instrument now stands at Nettlecombe Court, the seat of Sir Walter Trevelyan, to whom we are indebted for the following interesting copy of the original agreement :—

"February the 1st, 1665. Then made a bargain wth Sr Geo. Trevilyan for an "organ wth these stops in it as follows :

"One diapason
"One flute
"One recorde
"One fifteenth
} These in wood.
"One principall
"One flagilett
"One trumpett
"One shaking stopp
} These in mettle.

"And for this organ I am to have one hundred pound, 20*l*. whereof at the 25th "day of March next, and four-score residue thereof when the work is finished.

"John Loosemore."

This account is interesting as having in it a shaking stop, which was an attempt at our present tremulant. It only affected the lowest octave, and was confined to one stop, which met the "trumpett." There was a quaint arrangement which caused two gilt stars to revolve in the front of the case when the organ was used, and according to the direction of their revolutions the player ascertained if the bellows were being properly filled with wind. Loosemore died in 1681.

As regards Dallam, it is stated by Mr. Rimbault that there were three of that name, all the sons of an organ builder, and all following the same trade. Ralph Dallam built an organ at Lynn Regis, remarkable on account of its curious case; George and Robert Dallam built the organ for the Minster at York (1632). We here give an accurate copy of the original agreement for this organ, for which most interesting memento we are indebted to the present Dean, who most kindly procured it for us through Mr. Thiselton :—

"Articles of agreement, indented, made, concluded, and agreed upon, the one "and twentieth day of March, anno dmi 1632, and in the eight yeare of the reigne "of our souveraigne Lord Charles, by the grace of God, Kinge of England, Scot-

"land, France, and Ireland, defender of the faith, &c. Betweene the right worshippfull John Scott, doctor of divinitie, deane of the cathedrall and metropoliticall church of St. Peter of Yorke; Phinees Hodson, doctor of divinitie, chancellor and canon residentiary of the said church, George Stanhope, doctor of divinitie, precentor and canon residentiary of the same church; and Henry Wickham, doctor of divinitie, archdeacon of Yorke, and canon residentiary of the said church, of the one party; and Robert Dallam, cittizen and blacksmith of London, of the other party, touchinge the makeing of a great organ for the said church (as followeth): The names and number of the stoppes or setts of pipes for the said great organ, to be new made; every stopp containeing fiftie-one pipes; the said great organ containinge eight stoppes.

"In-primis two open diapasons of tynn to stand in sight, many of them to be chased	lxxx	li
"Item one diapason stopp of wood	x	li
"Item two principalls of tynn	xxiiij	li
"Itm one twelft to the diapason	viij	li
"Itm one small principall of tynn	vi	li
"Itm one recorder unison to the said small principall	vi	li
"Itm one two and twentieth	v	li
"Itm the great sound-board with conveyances, windchestes, carryages, and conduits of lead	xl	li
"Item the rowler board, carryages, and keys	xx	li
"The names and numbers of stoppes of pipes for the chaire organ every stopp containeinge fifty-one pipes, the said chaire organ containeinge five stoppes.		
"In-primis one diapason of wood	x	li
"Itm one principall of tynn to stand in sight many of them to be chased	xii	li
"Item one flute of wood	viij	li
"Itm one small principall of tynn	v	li
"Itm one recorder of tynn, unison to the voice	viij	li
"Itm the sound-bord, windchest, drawinge stoppes, conveyances, and conduits	xxx	li
"Itm the rowler board carryages and keys	x	li
"Itm the three bellowes with winde trunckes and iron workes, and other things thereto	xv	li
"Sume total	cclxxxvii	li

"It is agreed by and between the pties above said, and the said Robert Dallam doth covenant, promise, and grant for him, his executors and administrators, to and with the said deane and canons residentiary above named by these presents, that he, the said Robert Dallam, his executors or administrators, shall and will well and sufficiently and workemanlike new make and finishe the said organ in every the particulars before mentioned, accordinge to the true intent and meaninge hereof, before the feast of the nativitie of Saint John Baptist, which shall be in the yeare of our Lord God, one thousand six hundreth thirtie-four. In consideracon of which worke undertaken to be done as aforesaid the said Deane and canons residentiary above named have paid unto the said Robert Dallam in hand one hundred pounds, and doe promise to pay unto him the residue of the said sume of cclxxxvii li, as soone as the said worke shal be finished; and for the more speedy finisheinge of the said worke the said Deane and residentiaries are pleased to appointe the said Robert Dallam some convenient roome neare unto the said Cathedrall church to worke in. And further, the said Deane and residentiaries doe promise to pay to the said Robert Dallam towarde the charges of himselfe and servants in comeinge from London hither aboute the said worke, the sume of five pounds. In witnes whereof the parties above said to these present articles indented have interchangeably sett their hands and seals the day and yeare first above written."

This document is interesting as showing the manner in which the old builders set about their work. In another agreement, dated 1634, we find that the case for this instrument was made by other hands, which was no uncommon occurrence. Dallam did other work, but this seems to have been his *chef d'œuvre*. He died towards the close of the seventeenth century.

CHAPTER III.

1650 TO 1750.

Bernhard Schmidt—Renatus Harris—Harris, junr., and Byfield—Christopher Schreider—Jordan and Son—Messrs. Glyn and Parker—Christian and Gerard Smith—and Thomas Schwarbrook.

THE name of Schmidt, anglicised into Smith, will ever stand at the head of the list of those builders who are revered as masters of their art, and whose works are still valued for their accuracy and finish. As his name indicates, he was of German extraction, emigrating to this country about the middle of the seventeenth century, bringing with him his two nephews, Gerard and Christian, as his assistants, from whom he has always been distinguished by the title *Father* Smith. His works are of so much importance, and were so good, what remains to us being so justly esteemed, that it would be difficult to overrate his abilities; and although of course many undoubtedly great improvements and important additions have taken place in building since his day, nevertheless what work of his still exists is of such stirling value that it has hardly been surpassed by our best modern builders. The first organ he built in this country was for the Chapel Royal, Whitehall, which work, together with those erected by him for Westminster Abbey and St. Margaret's, Westminster, brought him under the notice of the king (Charles II.), who not only appointed him "organ builder in ordinary," but also gave him apartments in Whitehall.

In the choosing of his materials he was most particular, oak being his favourite for woodwork. He never allowed the slightest flaw to escape him, and rejected all wood with knots in it; and if after constructing a pipe, either of wood or metal, he found that in voicing it there was any defect as to speech or clearness, he invariably threw it aside, never to be again in his hands. Concerning his voicing it has hardly been surpassed, and it is now the proudest achievement a builder can attain to produce tones that are equal to those of this celebrity. It must be admitted that Smith had the advantage of introducing many stops that were hitherto unknown in this country, such as the *vox humana*, *cremona*, *double bassoon*, and *block flute*, of which we may mention the latter as appearing in almost all his organs; he also experienced that opposition which invariably acts as an advantageous stimulant, alike to the artist and the public, his great opponent being Renatus Harris, likewise a veteran in the cause, of whom we shall have occasion to speak presently.

Before entering into any account of Father Smith's organs, we would clearly place before our readers the extent of the instrument in his day. At the commencement of his career the swell was entirely unknown (being introduced by Jordan, 1712, of whom we shall have something to say in due course), so that, as a rule, there were only two rows of keys, viz., the great and the choir, to which was sometimes added an echo organ, bringing the number of claviers up to three as the maximum. The compass was from G G to C 2 in alt. The separate pedal organ was unknown, as were, of course, composition pedals.

The great work which brought Smith's name so prominently to the front, and which has since remained as a worthy monument to his memory, was the organ erected in the Temple Church. The Master and Benchers of the Temple, being desirous of obtaining a suitable instrument for their church, and, receiving tenders from Smith and Harris, were unable to decide to which of these worthies they should consign the task of furnishing the desired organ. With legal sagacity they perceived the advantages arising from emulative opposition, and it was arranged that each should build an instrument, place it in the church, and then, after fair trial, competent judges should pronounce which was the superior; by which decision the Benchers were willing to abide. The organs being built, and Smith and Harris obtaining their several champions to play thereon, it could not be agreed which was really the better; more stops were added to each, and eventually Father Smith obtained a memorable victory and a formidable enemy, his being declared the finer instrument. In a most interesting work by Edmund Macrory, M.A., called "A Few Notes on the Temple Organ," will be found a full account of the discussion from beginning to end, and also quotations from some documents much after the style of Dallam's agreement.

Smith's organ contained twenty-three stops, and the extraordinary addition of *quarter tones*,* A flat and D sharp being distinct from G sharp and E flat. The pipes were much crowded to get them in the space provided, but the organ has been reconstructed by Mr. Robson, who not only enlarged the plan and brought it up to modern requirements, but also added many important stops, and it still ranks as one of the finest organs of the metropolis, the musical services of this church, under the able direction of Mr. Hopkins, being among the first attractions of their kind in London.

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* Extra divisions of the octave have since been attempted from time to time, but the complications necessary were found to render precise manipulation so difficult that the idea has been practically abandoned. The Temple organ had fourteen divisions in the octave. An organ built by Messrs. Glyn and Parker, for the Foundling Hospital, had sixteen divisions; Hawkes' patent, seventeen; and Liston's enharmonic organ had as many as fifty-nine divisions in the octave, twenty-four of which were on the keys, and the rest governed by pedal arrangements.

Father Smith acquired such fame by this instrument, together with one he built for Durham Cathedral, that he received orders to construct one for St. Paul's Cathedral. This organ was not superior to the one at the Temple, and, therefore, we shall merely mention that the present instrument contains a *double-diapason* and a *block flute* (large fifteenth) of Father Smith's manufacture, together with part of the original case, perhaps some of the best work of Grinlin Gibbons.

It would be quite impossible in a work of this kind to specify all the organs attributed to Smith. We shall therefore confine ourselves to two more, viz., that of St. Catherine, Leadenhall-street, and the one at St. Peter's, Tiverton, Devon. It is an odd fact that Smith had almost always to contend against some adverse forces, and his work at St. Catherine's proved no exception, as he had to decrease the dimensions of his case to allow room for the charity children on either side thereof. Nevertheless the organ was a success, and is still a remaining instance of beautiful design. It was also noted for having the best *swell* in London, though that was not added by Smith, but probably just after his death.

As regards the organ at St. Peter's, Tiverton, it has a most interesting history, and will serve to show the vicissitudes to which an instrument is liable in its advance towards perfection. There has been some doubt as to whether it was built by Father Smith or his nephew, but Snetzler said it contained work by each of these, and it is probable that Christian Smith carried out his uncle's half-finished designs. It was originally purchased by subscription in 1696, and placed in the rood-loft. The organ bears the name of "BERNHARD SCHMIDT" on one of the front panels. In 1776, Paul Micheau repaired it, and gilded, probably more correctly *re*-gilded, the front pipes. After which a swell was added by Green. In 1826 it was removed to a West-end gallery, and in 1842 a pedal organ was added, consisting of a double open diapason. In 1845 the whole instrument was carefully repaired by Bishop, Green's swell being removed and another substituted. It is probable that about this time a solo organ was added, but this has since disappeared. In 1856 it was placed in a chamber in the north aisle, in which situation it suffered materially from damp. In 1867 it was entirely rebuilt by Mr. Henry Willis, and now consists of a great swell, choir, and pedal organ, respectively, containing in all thirty-three speaking stops, of which an open diapason in the great, a similar stop in the swell, as also a gemshorn, are of Smith's work. The original case remains, in the upper part of which is a row of Smith's pipes unused (a block-flute), as mentioned in Chap. II.

Smith was not only a builder, but also a performer, holding the position of organist at St. Margaret's, Westminster, up to his death, which happened, probably, in the year 1708. Before leaving Father Smith we must state that he was an indefatigable toiler at his art, building many instruments which have been scattered the length and breadth of the country, though there is much attributed to him that should be probably allowed some more recent artist. He was unquestionably the greatest builder of his time, and fully deserves the praise that is so freely accorded him as a careful, shrewd workman, who never sacrificed his labour and work to *cheapness*, never constructing an instrument except in accordance with his own views and experience, rather relinquishing an order than running the risk of erecting an organ that was not thoroughly praiseworthy, and perhaps to this quality more than any other he owes the secret of his universal success.

We shall now pass on to another great builder, who was only little inferior to Smith, and who was nevertheless his formidable rival on almost all important occasions.

Renatus Harris was originally of English extraction, but his family having migrated to the Continent, he again crossed to England with his father, whom he succeeded; and, having to compete with Dallam and Smith, had at first but little success, but gradually gaining ground, he at last established himself in this country on a firm footing, and was recognised as a most able builder. Perhaps it was the *fracas* over the Temple organ which brought Harris to the front more than anything, for not long after he was employed to supply an instrument for the cathedral at Salisbury, succeeded by one given to the Dean and Chapter by George the Third, built by Green, which now is replaced by an entirely modern one by Willis. Harris built many organs for the metropolis, one of the finest of which is still to be heard at St. Sepulchre's, Snow-hill; perhaps his next best being in the same vicinity—Christ Church, Newgate-street. Both these organs have been more or less altered, especially the latter, which has been rebuilt by Mr. Hill, and is now a truly magnificent instrument; the old cases remain, and are interesting specimens of design. Harris settled in Bristol towards the latter part of his career, building many fine organs for that city and the neighbourhood, and dying about the year 1715.

He left a son, John Harris, who entered into partnership with John Byfield, and by their united efforts they turned out some good work, among the most noted of which must be mentioned that of St. Mary Redcliffe. It is described in Barret's History of Bristol as "being in all 53ft. high from the ground to the top of the crown panel; the great case, about 20ft. square, contains one great and lesser organ . . . the whole cost £846 7s."

But a better account of it was found on a handbill among the papers of the late Mr. John Allen, organist of St. Mary Redcliffe, signed by Harris and Byfield themselves. It runs as follows:—

> This instrument is concert pitch; the compass or extent of the great organ is from double-double C-fa-ut to D-la-sol in alt. complete long octaves, containing 63 keys, and has the following stops, viz., two open diapasons, principal, a grand sexquialtra of 5 ranks, a trumpet, a clarion, a cornet of 5 ranks, a twelfth, a fifteenth, and a tierce. The three last stops are only from double gamut to D-la-sol in alt. The chair or choir organ is from double gamut to D-la-sol in alt, being long octaves containing 56 keys, and has the following stops: A stop'd diapason, a principal, a flute almain, a flute, a bassoon, a grand sexquialtra of three ranks. The eccohos (which are made to swell or express passion) is from gamut to D-la-sol in alt, being 44 keys, and has the following stops: The open diapason, the stop'd diapason, a principal, a flute, a cornet throughout, a trumpet, a hautboy, a vox humana, and a cromhorn. This organ contains 26 stops and 1928 valuable speaking pipes, which are considerably more than either the organ in S. Paul's Cathedral or that of S. Martin's Church, in London, contain, and are as well performed in every respect, notwithstanding this organ cost no more than £1000, which is vastly less than the price of either of the others, although the compass of St. Martin's is only from gamut to D-la-sol in alt, and St. Paul's has, we think, only the two diapasons and trumpet so low as S. Mary Redcliffe, and neither of these stops contain either the double-double C-fa-ut sharp or double-double D-sol-re sharp, which are expensive pipes, besides the C sharp and D in alt are not in any of the stops of the St. Paul's organ, although it cost three times the price of Redcliffe.
>
> N.B.—There are pedals to the lower octaves of this great organ, notwithstanding the touch is as good as need be desired, and there is an invention which, by drawing only a stop, makes it almost as loud again as it were before (or play in a double manner), though there are no new pipes added to the organ, or any keys put down by it. This great piece of work was completed within the time agreed upon, and was finished in little more than a year and a quarter, and was approved of as an excellent toned instrument.

According to this account, St. Mary Redcliffe was the first organ in England with pedals, though some authorities state that the pedals were added some time afterwards. It has since been renovated and restored by Mr. Vowles, of Bristol, to whom great praise is due for the careful manner in which the work has been executed. A full account of the present state of the instrument will be found in the "Bristol Church Guide,"* written by Mr. S. W. Lawson, the present organist, who also gives the past history of the organ.

These builders of course constructed many other instruments, which it would be impossible to particularise in a work of this calibre, we therefore pass on to Christopher Schreider, a German, who married one of Father Smith's daughters. He seems to have built several organs in the West of England. His *chef d'œuvre* was the organ at Westminster Abbey, though he also built an organ of some interest at Finedon, Northamptonshire, which has been wrongly attributed to Gerard Smith. It was opened on the 17th May, 1717, by Dr. Croft. Kent, who wrote so many beautiful anthems, was the first organist. It has been most judiciously restored by Mr. Holdich, who, in 1853, added pedal pipes, and in 1872 rebuilt it, retaining all the old work, together with the original case. In 1717 it consisted of a great, choir, and echo organ, the latter being from middle C to C in alt. The great and choir organs were what is called short octaves, *i.e.*, the note below C C was G G. The following is the original specification :

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* S. Colburn, publisher, Bristol.

Echo Organ.

Open diapason
Principal
Cornet
Trumpet

Great Organ.

Open diapason
Stop'd diapason
Principal
Twelfth
Fifteenth
Sesquialtera
Cornet
Trumpet

Choir Organ.

Stop'd diapason
Principal
Fifteenth
Cremona

The compass is now from C C to F in alt. on the manuals, and the instrument contains twenty speaking stops.

We mentioned just now that the swell was introduced previous to or immediately after the death of Father Smith, by "Jordan." It appears that Jordan was not brought up to the trade of organ building, but having a taste for mechanics, took up this art and invented the *swell*, which now of course is an essential to the instrument. The first *swells* or *swelling organs* were not constructed as they now are, with shutters, the *crescendo* and *diminuendo* effect being originally produced by causing the front of the echo-organ box to slide in a sash, like a window, under the control of a pedal. This clumsy arrangement continued until Green took the matter up, and introduced the *Venetian swell*, which yet remains to us much as he left it. Jordan's son followed his father's footsteps, and eventually entered into partnership with him. They produced some fine instruments, of which we shall mention two, viz., the one at the parish church, Southampton, and the one in the parish church, Yarmouth. The former has been restored and added to by Messrs. Bevington, and is now an average three manual instrument, containing about thirty-five stops in all. The latter was constructed in the year 1733, the original pipes are still in a good state of preservation. After passing through the hands of many builders, it was put under the able care of Messrs. Bishop and Sons, who have just finished alterations and additions, which place it among the first of provincial organs. It now contains fifty-three speaking stops, together with all the best inventions and accessories we can at present command. The Jordans were employed constantly in altering echo organs into swells; the former being enclosed in a box, required only the addition of a sliding shutter to produce the desired effect. We cannot fix the date of the elder Jordan's decease, but we believe that the younger Jordan died about 1750.

There were at this time other builders of great repute, viz., the junior Byfield, Messrs. Glyn and Parker (who built the organ at the Foundling Hospital, since restored by Bevington); Christian and Gerard Smith, were also independent builders, succeeding their uncle, Father Smith, who must not be passed over. Thomas Schwarbrook was also a celebrity, who built, among others, an organ for St. Chad's, Shrewsbury, having a remarkable case, to be mentioned hereafter.

* * *

CHAPTER IV.

1750 TO 1811.

John Snetzler—Samuel Green—Messrs. Crang and Hancock—John Avery —Richard Bridge—Byfield, Jun.—G. P. England—Paul Micheau.

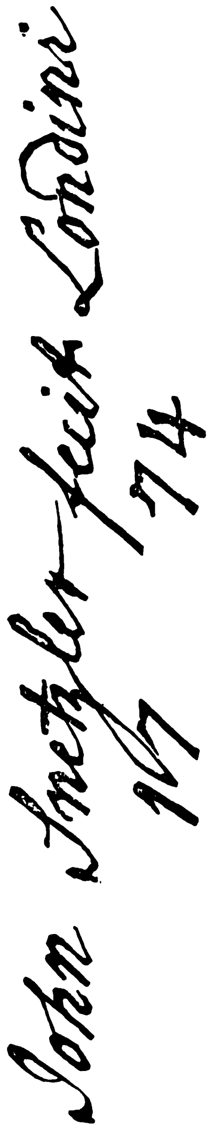
JOHN SNETZLER, a native of Germany, born 1710, was induced to come to this country to help meet the demand for organs which sprung up immediately after the Restoration, as a natural reaction to the fierce destruction that these and other ecclesiastical appurtenances suffered during that troubled period. He was the first to introduce, if he did not invent, the Dulciana, one of the most charming of our soft stops, and perhaps to this, together with sterling general work, may be attributed the success which attended his earlier efforts. The first organ he built in this country was at Lynn Regis, which, though passing through much molestation, is still of the same design and compass as when Snetzler left it. The next great work of this maker that we shall notice is of interest, inasmuch as we have the original and present condition of the instrument before us, and are thus afforded a good opportunity of seeing the progress that was made, as well as the state of the organ during the latter half of the last century.

In St. Martin's Church, Leicester, on September the 21st, 1774, was opened, by the performance of the Dettingen *Te Deum* and *Jubilate*, a three manual instrument, which, if we except the absence of pedal pipes, was up to the knowledge and attainments of that date. The original synopsis runs as follows :—

GREAT ORGAN.

Compass GG to e^3, no GG sharp, 57 notes.

		Feet
1.	Large open diapason	12
2.	Small ditto, 4 lowest notes, principal pipes groved into No. 3...	8
3.	Stopped diapason	12 tone
4.	Principal	6
5.	Twelfth	4
6.	Fifteenth	3
7.	Sesquialtera, 4 ranks	
8.	Mounted cornet 5 ranks from Mid. C to top.	
9.	Trumpet	12
10.	Clarion	6



John Snetzler fecit Londini 1774

CHOIR ORGAN.

Compass GG to e³, no GG sharp, 57 notes.

	Feet
1. Open diapason (4 lowest pipes all stopped)	12
2. St. diapason	12 tone
3. Principal	6
4. Flute	6
5. Fifteenth	3
6. Bassoon	12

SWELL ORGAN.

Compass Tenor F to e³, 36 notes.

	Feet
1. Open diapason	8
2. St. diapason	8 tone
3. Principal	4
4. Cornet, 2 ranks	
5. Hautboy	8
6. Trumpet	8

In one of the windchests of this organ was found Snetzler's autograph, of which we give a fac-simile.

With the exception of the want of pedals, which probably was not the fault of the builder, and the short swell, the instrument differed in no material particular from those of the present day.

In 1845 Mr. Holdich added pedal pipes, and in 1848 the organ was removed from the west gallery to the north transept, after which the mounted cornet was removed, and a claribella inserted in its place, part of the bassoon also gave way to a cremona; in 1870 it received additional pedals and two couplers. It has recently been completely rebuilt by Messrs. Walker and Sons, who incorporated all Snetzler's work, put an extra manual, and brought it up to the compass and requirements of the present day. The following analysis will show the additions, and what still remains to be done, and also gives an interesting review of the great steps that have taken place since Snetzler lived:

COMPARATIVE NUMBER AND SIZE OF STOPS OF ORGAN BEFORE AND AFTER REBUILDING.

	32 ft.	16 ft.	12 ft.	10⅔ ft.	8 ft.	6 ft.	4 ft.	3 ft.	2⅔ ft.	2 ft.	Mixture stops of				Couplers	Pedals for mechanical adjustment	Total No. of Stops, &c.
											Ranks V.	Ranks IV.	Ranks III.	Ranks II.			
Old	0	1	5	0	7	4	2	2	0	0	0	1	0	1	4	1	28
New	0	5	0	1	23	0	9	0	2	4	1	1	0	0	9	15	70
Prepared for	1	2	...	...	1	...	...	...	...	...	...	...	...	...	...	...	4

The old organ of Ripon Cathedral is supposed to have been by this maker, though, with the exception of four stops retained in the organ built by Booth, of Leeds, about fifty years since, nothing now remains.

Snetzler did an immense quantity of work, of which it is impossible to mention even a tithe, though we cannot pass over a little instrument which has come especially under our notice.

The late Earl of Egremont, when living at Bromley, Kent, bought at a sale a little chamber organ, and as the church of St. Decuman's, Somerset, had no instrument to lead the services, this was lent to the churchwardens, and has since remained in the edifice. It at once strikes the hearer as being superior in tone, and it is interesting in that it remains precisely as it left the workshop. It contains eight stops in all, of which three do not run through. Although there are no pedals and only one accessory movement (for commanding the stops), this little organ nevertheless is of great value, on account of its excellent tone and quality throughout. It bears Snetzler's autograph, and the date 1760.

Snetzler died in London at a great age, after having done perhaps as much work as any one builder could well get through. The date of his death seems doubtful, though it has been said that he even saw the birth of the present century.

Samuel Green, born 1740, was one of the many remarkable builders of this age. His name is connected with such a number of works, scattered over so large an area, that it is difficult to find a county without some specimen thereof. He devoted much time to the scientific advancement of the action, &c.; and, like many worthy pioneers in art and science, to his love for the true source of benefit to his profession, he sacrificed that worldly wealth which so often falls to the lot of the ordinary plodder instead of to the inventive genius. Thus we find a pathetic appeal on his behalf in the *Gentleman's Magazine*, together with a complete list of all his organs, which, having been republished, it is unnecessary to repeat here. Green was considered a first-rate maker and voicer of reeds. He paid much attention to the swell department, where he introduced the Venetian shutters in place of the old sliding front. He also greatly extended the compass of this manual, in one case, at least, going so low as tenor C. His masterpiece was the organ of Canterbury Cathedral, which, with the exception of seven pedal pipes added in 1825, still remains as he left it; it was opened 8th July, 1784, by Dr. Hodges, then professor of music at Oxford. The instrument contained the almost unprecedented number of 2500 pipes. Green built the organ presented to Salisbury Cathedral by George III., on the west front of which appeared the following:—

MUNIFICENTIA
GEORGII TERTIA
CLEMENTISSIMA PIETISSIMI OPTIMI
PATRIS PATRIÆ
ET
HUJUSCE DIŒCESIOS
INCOLAE AUGUSTISSIMA.

This organ has been replaced by an entirely modern one by Willis. Green died in 1796, aged 56. It is remarkable that in this builder's largest instruments there were no accessory movements whatever to assist the performer.

Messrs. Crang and Hancock were a firm who built many organs of considerable note about this time. As an instance of their work we will cite the organ at Chelmsford parish church—a three-manual instrument, containing some good diapason work, and of a pleasing quality throughout. It has been renovated by Messrs. Hill and Son, and moved from a damp west corner to the north side of the aisle, and were it not that the swell only reaches tenor C, would be a complete though unpretending instrument. The date of the work is 1772. Hancock was noted as a good voicer of reeds.

John Avery was a builder whose name is honoured as that of a master in the art, he having built organs dating from 1775 to the beginning of the present century. He built one at St. Stephen's, Coleman-street (1775)—three manuals, compass G G to E in alt; no G G sharp, no couplers or pedal pipes. Avery also built an organ of some size (twenty-seven speaking stops) at St. Margaret's, Westminster, the church where Smith's second organ in this country stood. The date of Avery's is 1804.

Richard Bridge was another celebrity who flourished at this period. He built the organ at St. Leonard's, Shoreditch, 1757, containing twenty-five speaking stops. Bridge has had ascribed to him the honour of building the fine organ at Christ Church, Spitalfields, though Jordan and Byfield, jun., shared the work with him.

Byfield also built an instrument at St. Mary, Rotherhithe, 1764, though this organ is not of great interest in itself, being small and incomplete.

The Englands, father and son, were builders who attracted much attention. A good instance of the father's work may be seen at St. Luke's, Chelsea. Of the son, G. P. England, one of his best works now remains at the parish church, Lancaster, on a brass plate, in the front of which is the following inscription: "G. P. ENGLAND, LONDINI, FECIT, 1811." It is an extremely good organ, and has been enlarged by Mr. Hill (1873), who retained all England's work. Originally it contained twenty-two stops, the diapasons being specially noticeable for their quality and even speech.

Paul Micheau was a local builder of this period of some repute, his name being preserved to us in connection with Loosemore's organ at Exeter, in which city Micheau settled, and Father Smith's organ at Tiverton, both of which instruments he kept in repair. He built many organs in Exeter and the neighbourhood, though we have been able to trace none of those now existing to him.

In mentioning the organ builders who succeeded those of whom we have just spoken, names still familiar to us as first-rate builders crop up; the firms of the present best builders in many instances being inherited from fathers who combined to make the modern organ the magnificent structure it now appears, and who, carefully treasuring the experience of the past, allowed the rapid progress of steam and consequently elaborate machinery, which will be the abiding sign of this our nineteenth century, to aid them in the advancement of their noble calling. To all such as are acquainted with or interested in organs of the present day, such names as Gray, Bishop, Hill, Bryceson, and Bevington must be household words; and these, together with others, fortunately enough for us indeed, too numerous to mention, are those whose names and sons, still among us, assist in turning out the finest instruments the world has seen.

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CHAPTER V.

Old Cases—Foreign Builders in England.

We cannot close the historical portion of this work without mentioning that hitherto much-neglected item in the art of organ building, the case, which until lately has been considered of so secondary a consideration as to require little care and less study.

The organ case in days gone by was by no means an unimportant part of the work, and was for many years considered of such consequence that it was put into the hands of a different set of workmen, and looked upon as a separate though in no way trifling part of the whole. It will be remembered that, even in the days of Aldhelm, the case attracted attention, as he described the instrument as "inclosed in a gilded case." ("Early English Church," Chap. 7, page 131.)

In the York archives it will be seen that Dallam's organ was specially embellished, for in a document dated 1634, concerning general ecclesiastical expenditure, we come upon the following:

> "Itm. paid to Christopher Richardson, carver, for himselfe and his man, for their
> "charges in comeinge from Durham hither, and bringinge their tooles with them;
> "xiij*s*. Itm paid to the said Ch$^{\underline{rofer}}$ Richardson, for himselfe and his man, for
> "workeinge at the organ case at the rate of xx*s* a week for 52 weeks, vidt the first
> "bегininge the xxii*th*. of September 1633, and the last endinge the xvij*th* of
> "October 1634. Lii*li*. * * * * Itm paid to Francis Harrison, joyner, for makeinge
> "the canopy over the organ vi*li*. * * * * Itm paid to William Wilson, joyner,
> "upon agreement with him for worke and stuffe about the organ case xlvi*li*. * * *
> "Itm paid the xxiiij*th* of November 1634 to the said Willm. Wilson, upon his
> "note, for boards, &c., and worke done at the front and the canopie over the organ
> "xxii*s* iiijd. Itm paid to him for makeing pyramides for the toppes of the organ
> "and other worke about the same ix*s*."

The whole document is far too long to copy entirely, but it goes on to show that "three hundred of ten penny nails" were "used about the canopie alone." It will be seen that no less than £52 and £46 were paid on several occasions for the work of this case, which in those days was a great sum of money for such a purpose.

The organ at Lynn Regis was remarkable as having a beautifully carved oak case, which represented King David playing on the harp, together with several *moving* figures beating time. The organ at St. Chad's, Shrewsbury, by Thomas Schwarbrook, also has a similar design, in mahogany. On the Continent the organ case was a work of art in the highest sense of the term. Cremona (Italy) boasted several grand cases. At St. Anne's, Augsburg, no less a genius than the elder Holbein painted the doors (panels ?) of the organ case. At Gonesse, in France, is a beautiful case of cinque-cento work, the date thereon being 1508.

The organ case at Bois-le-duc, in Holland, is a magnificent structure of solid black oak. There is one in our own country of particular beauty in the chapel at Hatfield Hall, Northamptonshire, being work of the first quarter of the seventeenth century. The cases at King's College Chapel, Cambridge, and St. Peter's, Mancroft, Norwich, are also remarkably fine specimens. The case at St. Paul's Cathedral is the work of Grinlin Gibbons. There is an oddity in cases to be found at Magdalen College, Oxford, where the choir organ is enclosed in stone work. There are, of course, other instances of old work, but these will suffice as examples.

For many years the organ was looked upon by the architect as a necessary evil, and seldom, if ever, considered in the plan of the building. Smith had a great fight with Sir Christopher Wren about the organ of St. Paul's, and finally had to cramp his instrument, to its serious cost. It is only within the last few years that people are again beginning to see that organs can be made ornaments as easily, or nearly so, as disfigurements to the buildings they inhabit. St. Mary's, Northampton, built by Messrs. Bishop and Starr, is inclosed in a case designed by Sir Gilbert Scott, and almost all organs built now are either ornamented with carving or more or less elaborate decoration; and be it observed, however crudely such decorations may be carried out, they nevertheless point in the right direction, and show at least a desire for art, if not the power of producing it. Look at the cases of Snetzler's organs, and see the care which they betray in their construction. Heavy they are, perhaps, but bold in design, and, above all things, useful, and not a mere collection of dummy pipes in barbarous taste and villainous execution.

It is refreshing to observe that the beauty of the appearance of the instrument is being studied not only by organ builders, but by architects, who often hold these matters in the balance; and there is no reason why the coming generation may not possess instruments as striking in design as they are perfect in internal mechanism.

Before finally leaving the subject of builders, we would mention the fact that, although we have now sufficient native talent to supply our wants, nevertheless there is still found enough room for the foreign builder to display his powers. The Germans build organs of a particular stamp, which has up to this date more or less remained to them. They advocate "doubles," *i.e.*, 16ft. pipes, on the manuals, and also a great quantity of mixture; and although in large instruments the sixteen feet tone doubtless is essential, and adds a solidity to the general effect, it is carried a little too far by our German *confrères*, who almost invariably begin the lists of stops in even the smaller instruments by a double diapason or bourdon. We do not wish to detract from the honour of those whose fathers taught ours, but merely to point out that they somewhat too closely adhere to the heavy and the ponderous in organs.

In the Town Hall, Northampton, is an instrument built by Schulze, of Pauligne, North Germany, which is typical of what we have just been saying, possessing eight stops on the great organ, of which one is 16ft. tone, four are 8ft. tone, one is 4ft. tone; the other two containing seven ranks of mixture (no reed on the great manual).

The swell is by Stoltz, of Paris, and contains twelve stops, and, according to the account kindly given us by Mr. Koskell, contains no mutation stops whatever, though there are four reeds, one of which is 16ft., the others being 8ft. The effect of this cannot but be heavy in the extreme. It is most interesting to note that the French and German work in this organ show an evenness of scale, the open diapason in each case being 3¼in. diameter (tenor C).

In the same town, in All Saints Church, there has been erected, under the direction of Mr. Koskell, a very fine instrument containing fifty-two speaking stops, but which claims especial attention as having a most ingenious arrangement by which the *choir* and the *echo swell*, being in every respect separate organs, are brought by means of a special stop, which transfers the wind from one set to the other set of pipes on to one set of keys (a most useful adaptation of the "Ventil" system), thus obviating the necessity for five distinct manuals without in any way reducing the resources of the instrument.

The French have adopted a plan with regard to the regulation of their stops termed the "Ventil system," mentioned above, which distinguishes their instruments from those generally in use in this country.

As regards this "Ventil system," we may here explain that it consists in controlling the wind supply to the various stops by means of pedals, which, although commanding the number of stops supplied with wind, do not alter the state of the register-knobs. Thus, for instance, if the pedal commanding the "full organ" be brought into action, and only half the register-knobs are drawn, then only half the power of the instrument is produced; and, on the other hand, if all the register-knobs are drawn, and the pedal commanding a few soft stops is brought to bear, then only those stops are made to speak. This has led to some confusion, inasmuch as the apparent state of the organ, as seen by the registers, may be at great variance from its actual condition as controlled by the ventil pedals, and, unless thoroughly *au fait* at the individual instrument, the performer scarcely knows what he really has in action. We cannot see the advantage of the system over ordinary pedals in use in England, by which the registers are moved, and the organist at once sees by the knobs what is the exact state of affairs.

We have several specimens of French organs in this country; as instances we mention the one at the Carmelite Church, Kensington, built by Cavaillé-Coll (Paris), and also the one at the French Church, Leicester-square. The organ at the former church is entirely inclosed in a vertical swell, which is commanded by a special pedal, irrespective of the usual swell manual, which has its own independent swell action also. The result of this arrangement is very useful, and produces a fine effect of distance, and softens the general effect, which softness of course can be entirely banished by fixing the shutters open.

M. Cavaillé-Coll has also erected a fine three-manual instrument in the Town Hall, Manchester, which was opened by Mr. W. T. Best, July 18, 1877; it contains forty-three speaking stops, and no less than twenty-four composition pedals. Although the French have been accused of harshness and instability of workmanship, they have, on the other hand, borne the palm for the production of some of the more modern light stops, such as the *voix celeste*, &c., and are especially noted for the production of the *vox humana*, which stop is frequently made and voiced in Paris and sent over for insertion into our English instruments.

The organ erected at the Bow and Bromley Institute, which is a remarkably efficient two-manual instrument, without pretensions to size, is made on the "Ventil system," and seems to answer well, though we do not apprehend that we shall ever adopt the idea generally in this country.

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CHAPTER VI.

Oddities in organ building—Its position—Present condition of perfection.

It is but natural that, in glancing through the united organs of all ages and nations, the interested student of the subject is occasionally startled by some curious oddity, an experiment, or caprice of a builder or client. Of course experimental trials of various materials and movements have always been, and will continue to be made. But we allude to more peculiar eccentricities than those natural to the ingenious explorer. It will be remembered that the organ sent to Pepin the Short is mentioned as having pipes of *lead,* whereas the one described by William of Malmsbury had *brass* pipes. Earl Ethelwin, again, gave £30 for *copper* pipes for the organ in the Abbey of Ramsay. All these are more or less curious, but must give place to foreign eccentricities of later date.

In that remarkable building, half monastery, half palace, the caprice of Philip II. of Spain, named the Escurial, tradition places an organ made of *silver*; and, taking into consideration the abundance of that metal in the country, there seems no reason why some generous grandee should not have had an instrument made thereof, and presented it to the establishment. At Saintes, in France, was built, by one Father Julian, an organ of *pasteboard,* which is credited with agreeable tones; whereas, in Paris, it is asserted that, some time ago, an organ was built of *playing cards.*

Seidel, organist at Breslau, mentions an organ, spoken of by Prætorius, of which the keys, pipes, keyboard, nay even the outside of the bellows, were of *alabaster.* The same authority speaks of the quaint external embellishment of organs, and says that "The whole case was ornamented with statues, heads of angels, vases, foliage, and even figures of animals. The lips of the pipes were changed into iron jaws, or some other figures were driven into the pipes. . . . Among these ornaments the figures of angels played a conspicuous part; trumpets were placed in their hands, which they could move to and from their mouth. Carillons (chimes) too and kettledrums were handled by these angels. Not unfrequently there was in the midst of this heavenly host some bigger angel soaring above the others in an artificial sea, and beating with his *bâton* the time for his super-earthly orchestra. Under such circumstances the firmament could not be dispensed with, there were running suns and moons, and moving jingling stars (called cymbal stars). Even the host of the animal kingdom was summoned, songs of nightingales, cries of the cuckoo, celebrated Holy Christmas, and proclaimed to the Christian assembly the birth of the Redeemer; and eagles flapped their wings or flew towards an artificial sun. The crown, however, of all these absurdities was the *fox's tail*. It was intended to frighten away from the organ all those curious and inquisitive persons who, by thronging round it, often disturbed the organist. Thus, when they pulled out this stop, suddenly a large fox tail flew in their faces. . . . Another absurd contrivance is the tremolando, a register which on funeral services, fast days, and on Good Fridays, was to indicate the sobbing, sighing, and trembling of men."

All this, according to Siedel, occurred in the course of the 17th and beginning of the 18th centuries. Many other strange vagaries of organ building might be mentioned, but the above will serve as instances.

There is one point which does not come under the head of organ history or building proper, but which is of such vast importance that it would be a serious mistake to omit it. We allude to the position taken by organs in the buildings they inhabit. We think that it will be admitted on all sides that even now by far the majority of organs are erected in churches or other sacred edifices. Therefore we shall first treat of the ecclesiastical bearings on the subject.

Dr. Burney, in his work (1776), says that in the Lutheran Church at Dresden "there is a projection for the communion-table, over which is placed a most magnificent organ. This is the only instance I can recollect of an organ being placed at the east end of a church."

For many years it was usual in cathedrals to have several organs, and they frequently appeared at different parts of the large building, though in some cases they were all together, as at the cathedral church of Toulouse, where, in 1463, there were five organs all placed on the rood screen. The French often place one small organ in the chancel, with a large one at the west end of the building. This arrangement has been adopted recently in many large churches, with a view to facilitate the singing of small congregations during weekday services, by means of the lesser instrument, the larger being used on Sundays, or as occasion may require.

Up to a very recent date—in fact, until the revival of church music set in, at about the middle of the present century—the usual position of the church organ in this country was in a west-end gallery, and, whatever may be said to the contrary, we hold that, as far as the instrument itself is concerned, it is generally the best position it can occupy. But then it does not require demonstration that the organ is not placed in sacred buildings to show its own powers (which are a secondary, however important, consideration), but for the better conducting and leading the choir or congregation; and as it was found that a few squalling school children, running riot in a high gallery, did little to induce the congregation either to join or become interested in the music, the choir was moved to their midst, and was placed in or near the chancel. The removal of the organ then became essential, as except in rare cases of proficiency, singers find it most difficult to keep with the organ if separated more than forty or fifty feet at the outside; so that now all new organs, and most of the old, are found towards the east end of the church, in the chancel. And under these circumstances, more than ever, it rests with the architect—or, if not a new building, with the organ builder—as to what the result may be. If the instrument be inclosed in an organ chamber of false acoustic properties, to which the charge of dampness may be but too frequently an additional stigma, or if it be jammed into a corner with its best pipes against the ceiling, how much may be lost; whereas if, on the other hand, the architecture and resonance of the building be taken into account, it is not often that there will be any difficulty in recognising a position which may answer the requirements of the vocal necessities, and at the same time lose little of the qualities of the instrument in question.

In sacred buildings of a very large size it often becomes impossible so to place an organ that it may be advantageously heard at all quarters. This is forcibly demonstrated in our Metropolitan Cathedral, for if in St. Paul's you desire to hear a fugue or any running music, it is necessary that you stand close under the instrument, as all passages have a tendency to run together as you advance under the dome, until at a certain distance you absolutely cease to distinguish any rapid passages accurately; on the other hand, a sustained chord is heard at its very best at a point where *staccato* music would be mere chaos.

In considering secular buildings, such as concert rooms, town halls, &c., it is clear that a far greater latitude in position is attainable, inasmuch as the organ can be placed in any part thereof indifferently; and therefore, when great mistakes occur, they must be due either to the ignorance or negligence of those whose duty it was either to provide a place for the instrument, or an instrument for the place.

It must not be thought that an organ cannot be too powerful; the error of over-organing a building is only too common, and then the result is unfair on all sides. If, when it is proposed to erect a building where an organ is required, the architect and organ builder are placed *en rapport* at the outset, it often saves much money and more annoyance, and under such circumstances it is seldom that any very serious error is committed on either side, each being a salutary check on the other. There are numberless good organs struggling under the disadvantages of position, which, if only released from their cruel bondage, would become different instruments in the ears of their abusers; and we cannot too strongly point out that the first step in organ construction is to arrange its position, size, and power in strict relation to the building that it is destined either to disfigure or adorn.

In concluding this brief and imperfect sketch of the history of the organ, it will be interesting to compare the relative sizes and magnitude of two of the most celebrated continental instruments, built up to the lights of their several dates, with an organ of modern construction, possessing the later improvements and additions. We would premise that it has been found advisable in modern building to reduce the manual compass in the bass up to C C, extending the pedal down to C C C, or in the case of 32ft. pipes to C C C C, the advantage of this is apparent, as the five notes below C C would only be used singly as bass, and by reducing the manual and extending the pedal the rest of the octave for that purpose is gained, and a desirable uniformity attained. This compass has been long used in Germany, and was introduced into this country by Dr. Gauntlett.

The Haarlem Organ.—Built by Christian Müller, of Amsterdam, was commenced in 1735 and finished in 1738, occupying 3½ years in construction. It contains 60 sounding stops, all running through, except the cornet and hautboy in the great organ. The 32ft. metal pedal pipe in the front tower is 39ft. long and 15in. in diameter. There are two stops of 32ft. speaking length on the pedals. The organ has no composition pedals or other mechanical appliances, except two couplers and a tremulant. It stands 90ft. high, 50ft. broad, and 14ft. deep.

The Freiburg Organ.—Built by Aloise Mooser, of Freiburg, was commenced in 1827 and finished in 1834, occupying nearly 8 years in construction. It contains 61 sounding stops, all of which run through. The organ has no stop of 32ft. speaking length upon the pedals, and has no composition pedals or other mechanical accessory movements.

The Regent's Park Organ.—Built by Bryceson Brothers, of London, was commenced in 1872 and finished in 1875, occupying over 3 years in construction. It contains 65 sounding stops, all of which are through stops of 5 octaves, and a carillon of 61 metal bells. The 32ft. metal pedal pipe in the central tower is 38ft. long and 20in. in diameter. There are two stops of 32ft. speaking length on the pedals. The organ has 9 couplers and 21 mechanical combination and accessory movements.

Notwithstanding the great number of organs throughout England, there are few that can be classed as complete *orchestral* instruments. Only of late years have the large provincial towns been erecting in their public buildings organs suitable for recitals or concerts ; and even in the metropolis, the number of organs accessible to the people can be counted on the fingers of one hand. This state of things is happily gradually altering, it having been found that the public only require the opportunity to at once respond cordially and attend recitals. And as these entertainments increase, so will suitable instruments become less rare, and we may confidently hope that the organ recital may soon be classed among the recognised recreations for the thousands who would be only too glad to attend them. No one can observe the avidity with which a musical crowd flock to a recital without seeing how much may be done to educate and raise a taste already stirred towards the better music of the best instrument. That such entertainments are deemed healthy may be seen by the manner in which our clergy are frequently opening the doors of their churches for sacred recitals, which of necessity act upon those higher feelings it is our pleasant duty to cultivate and foster.

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PART II.

CONSTRUCTION.

CHAPTER I.

Material—Essential Parts—The Bellows.

The subject of construction is of such great scope, that in entering its precincts we would warn our readers that we can merely hope to give them a clear idea of the various parts of an organ, together with the manner in which those parts should be constructed, that they may be able the more readily to judge of any instruments brought under their notice, and discover without difficulty those internal defects which stamp an organ as inferior, or by their absence proclaim it the offspring of a good workman. The art of carpentry we cannot entertain here; and though it may be possible for an amateur already versed therein to build from our description an organ, it would be hopeless for him who is not an adept in the use of the tools to attempt to construct an instrument by the aid of the following chapters. We should, to render such possible, have to wade through all the more delicate and intricate paths travelled by the skilled artificer in attaining his prowess, which in itself would form a prodigious volume, without in any direct way teaching aught of organs in particular. On the other hand, it is our great object to render it a work of ease to all who may have occasion or desire to set right any of the thousand-and-one little errors, which so often render an organ for the time being useless, more especially in those provincial districts far from the workshop, and to which the tuner comes only at long intervals; as also to be competent judges of the value of any or every organ on the merits of which they may be called upon to decide.

Before entering into any description whatever of the organ, we must point out that in this, more than any other instrument, it is essential to use the best materials throughout its entire construction. This cannot be too emphatically enforced, for the organ is so compound an instrument that any failure on the part of internal mechanism may be attended with results at once serious and expensive. Not only does this hold good with regard to the pipes and sound-producing elements, but also to the sound-commanding portions, and we are not going too far in asserting that no builder, however skilled, can produce an organ worthy the name out of any save the best materials. It is seen in the art of pianoforte manufacture how overwhelming an advantage the large firms hold over the small makers who from time to time start on their own account. This is almost entirely owing to the fact that the former, having capital, can afford to keep and *season* their own wood, which the small tradesman has neither the room to warehouse nor the money to procure. This being the case in relation to the pianoforte, how much more must it apply to the organ, whose mechanism is so much more delicate, so much greater in extent, and so difficult of access? Seasoning is the guard against warping, and well-seasoned wood assumes the shape that it will retain until, overcome by age, it goes the way of all matter. How necessary, therefore, is it that the organ, perhaps miles from the factory or skilled workman, with its long trackers, delicate draw-stop action, and the like, should be at once free from the possibility of so serious a fault, and that it should be able to withstand fair tests and atmospheric influences without undergoing this fatal change. Let the dictum of him who would have an organ, and not a troublesome wheezing machine, be ever, *seasoned wood, best material,* from the ivory on the keyboard to the varnish on the case. As regards this seasoning it may be well to mention that there has been a method introduced of subjecting wood to a species of baking in a heated chamber, which takes the place of ordinary seasoning, but as it sometimes warps after this process, it must be banished at once as useless to the organ builder, however useful it may be in saving time in other trades. Seasoning proper is effected by subjecting wood, first, to the action of the atmosphere and water, by floating in a reservoir or exposing to the rain, for such a time as will ensure the absence of vegetable life or sap, and afterwards stacking it in covered sheds or warehouses, where it is exposed to the dry air. Well seasoned wood is sapless, and under fair circumstances has no tendency to change its shape.

In describing the various parts of an organ we shall confine ourself at first to those which are essential to the ordinary instrument, leaving the more recent and less necessary actions for future consideration. There are two great divisions in the parts of an organ—those concerned in *sound-producing* and those concerned in *sound-commanding*—after which there is an immediate and natural division between those parts connected with the collection, reservation, and distribution of *wind,* and those in relation to the various actions called in to aid in the command of the said distribution.

The names of the more important of these parts are as follow:

Bellows, *Windtrunk*, *Windchest*, *Top-board*, and *Pipes*, to which must be added the actions in connection with the several claviers, registers, &c. The following table may make matters a little clearer:

- I.—SOUND PRODUCING :—
  - *A*. PIPES.
  - *B*. WIND
    - *a*. Collecting—*Bellows*.
    - *b*. Reserving—*Windchest*.
    - *c*. Distributing
      - 1. *Windtrunk*.
      - 2. *Top-board*.
- II.—SOUND COMMANDING :—
  - *A*. CLAVIER ACTIONS.
  - *B*. REGISTER ACTIONS.
  - *C*. SLIDERS.

There are, of course, many important matters not mentioned in the table that are essential, and which will be fully described, but the above are the great divisions it is necessary at once to understand. In speaking of each one separately, its use, position, and surroundings will be fully entered into. Taking them in turn, we first should arrive at *the Bellows*, which are the wind collectors of the instrument, and whose soundness and perfection are of paramount importance.

There are two kinds of bellows that have been used for organs, *diagonal* and *horizontal*, but as it was found that it required many diagonal bellows to supply even an ordinary instrument, they have been almost entirely superseded by the horizontal kind. We therefore shall not describe the former, but proceed at once to a description of those which are now generally used.

Bellows consist of two parts, termed respectively the "Feeder" and the "Reservoir," of which the reservoir is generally placed immediately over the feeder. These parts consist of three layers of wood, called respectively the *top-board* (T T, Fig. 6), *middle-board* (M M, Fig. 6), and *bottom-board* (B, Fig. 6), in direct relation to their position as regards each other. The size of these must depend entirely on the instrument they are destined to supply. The top-board in large organs is often made with a frame and panels like an ordinary house door, and it is convenient always to have a movable panel in order to be able to reach valves in the middle-board if at any time necessary. The *middle-board* is made larger than either the top-board or feeders, and is a fixture, being placed in a frame which supports the whole bellows; it is, therefore, necessary that it should be made very strong. On the middle-board is attached *the band* (B B B B, Fig. 7), which is composed of thick boards placed edgeways round the middle-board, and inclosing the same space as is the size of the top-board. The use of this band is for the insertion of the wind trunk or trunks. The outside of the band is marked *n n* in Fig. 6, and the wind trunk W. It is often usual to place little posts on the middle-board of the same height as the band, *plus* the thickness of the ribs of the bellows, so as to bear the pressure of the top-boards and weights. In the middle board are placed *suckers* (*S S S S*, Fig. 7), *i.e.*, holes provided with leather valves on the top. These valves are made of one or more thicknesses of leather with a single layer as a hinge—in some organs the hinge of these is entirely dispensed with by having a piece of leather attached on all sides by little pieces of tape, about an inch or so long, which allow the valve to rise when necessary, and keep it in place over the hole when it again falls. It is well that this middle-board be also provided with a sliding panel, or some such arrangement, that it may be more easy to reach the bottom-board when required. The *bottom-board* (Fig. 8) is made of thick pine, as should be the others, and is *bound*, to prevent its giving way under great pressure. It, again, is provided with *suckers* (*S S S S*, Fig. 8), and forms the bottom of the *feeder* (B B, Fig. 6). It is not necessary that the bottom-board be as large as the top-board, in fact, it will be seen directly that the feeder is generally smaller.

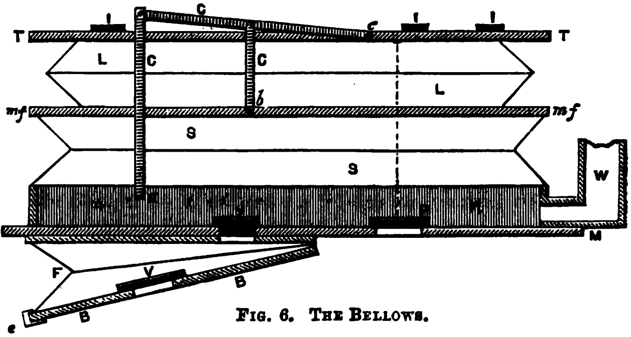

FIG. 6. THE BELLOWS.

The *ribs* of the bellows are pieces of wood forming the *folds*. They should be strong, not less than ¼in. thick, or thicker in proportion to their length. There are two kinds of ribs in use, *parallel* and *triangular*; the parallel being again divisible into two kinds, those which have their *larger* sides contiguous (L L, Fig. 6), and are used for the upper portion of the reservoir, and those which have their *shorter* sides together, and are used for the under part of the reservoir (S S, Fig. 6); of the triangular ribs, a good example is seen in the feeder (F, Fig. 6). Sixteen ribs are used in the reservoir of bellows, and these are arranged four on either side and four at each end, those above being divided from the lower ones by a wooden frame called the *middle-frame* (*m f*, Fig. 6). As regards the valves or suckers in the bottom-board and middle-board, they are marked V V, Fig. 6. It is immaterial what shape they assume, though they are usually made oblong.

The action of the bellows is easily understood. When the end of the feeder, marked *e*, Fig. 6, descends, the valve V in the bottom-board is forced open; the end *e* being again drawn up, the valve V in the middle-board is lifted, and the wind is transferred to the reservoir, the weights on the top of which (I I I, Fig. 6) pressing down the top-board, force it through the wind trunk (W), to be distributed over the organ. It will be seen that as the wind is forced through the valve in the middle-board the folds S S and L L expand, and again contract as the wind is forced into the wind trunk. The strain thus set up is counter-balanced by the middle-frame. It was found that the wind did not act with a uniform pressure on the pipes unless the folds S S and L L were made the one to open outwards and the under to open inwards; thus, as it were, each counteracting the other. It was also apparent that, to have a steady supply of wind, these folds should contract and expand equally and together, to effect which an arrangement of what are called *counter balancers* is used (C C C, Fig. 6), which consists of a light framework attached to the band, middle-frame, and top-board (*a b c*, Fig. 6). By

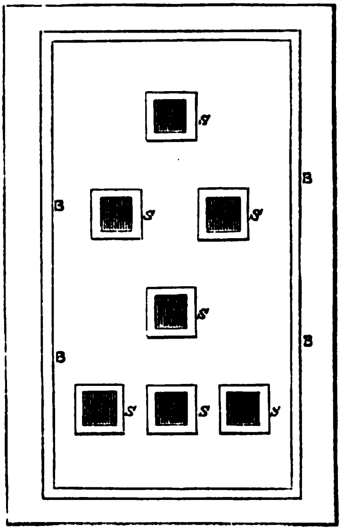

Fig. 7. The Middle-Board.

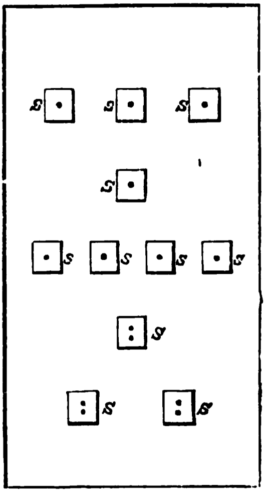

Fig. 8. The Bottom-Board.

this contrivance each fold is kept open or shut in proportion to its fellow, and the descent of top-board with its weights is also steadied.

The *waste-pallet* (P, Fig. 6) is an arrangement corresponding to the safety-valve in the steamboiler, and prevents an over accumulation of wind, and consequently undue pressure, in the reservoir. There have been several kinds in use, but perhaps the best is the one represented in the cut, which consists of a valve of leather in the middle-board, to which is attached a light chain or cord, the other end of which is fixed in the top-board, so that when the wind expands the reservoir beyond the length of the string, the pallet P is lifted, and the superfluous wind escapes. A contrivance called the *cuckoo-feeder* has been invented (Fig. 9) which in reality is two feeders with one bottom-board. The bottom-board, instead of being fixed at one end to the middle-board, as in Fig. 6, is here placed on a piece of wood, running beneath the middle-board (W, Fig. 9). Each half is made exactly like a separate feeder, with their points fixed to the top of the piece of wood W, and a leather lining covers the space marked L L, Fig. 9. It is a far better plan to use the feeders separately made, which arrangement is called a *double-feeder*, an advantage of which is that at any time one can be repaired without affecting the action of the other. In very large instruments the feeder is not placed contiguous to the reservoir, there frequently being many of the latter of different weights of wind.

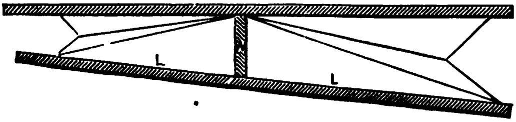

FIG. 9. CUCKOO FEEDER.

It was found that any sudden changes in the amount of wind withdrawn from the reservoir caused a momentary unsteadiness in the supply to the pipes. This was obviated by an ingenious invention called the *concussion bellows*, a triangular reservoir placed over a valve in the wind trunk, to the back of which is fixed a spring, which is set to exactly balance the *usual* pressure of the wind in the bellows. If at any moment this pressure is increased, as by the sudden discontinuance of stops, &c., the spring *gives*, and the concussion is here received, instead of being felt at the pipes.

The *bellows action* which moves the feeder will be easily understood by a glance at Fig. 10. It resembles an ordinary pump action, having the lower ends (L L) attached to a wooden fork at the end of the feeder, or feeders, called the *lug* (*l l*). The upper ends are secured in like manner on either side if there are two feeders, or towards the end if only one, of the larger lever, which again communicates in the same way to the actual bellows handle, which handle protrudes from the organ case, and works on a spindle.

In constructing the reservoir, the ribs are assorted in pairs, and strips of white dressed leather are glued over the edges that join, the same operation being performed on the other side. These pieces form the *middle joint*. All the couples are made in the same manner, and then the upper edges are joined to the top-board; the lower edge of the upper series is attached to the *inner* edge of the middle frame; the upper edge of the lower series joined to the outer edge of the middle-frame; the openings at the corners are closed with leather. The feeder is made in the same manner, only the end is fixed firmly to the middle board by a leather joint, which must again be covered with leather to render it air-tight.

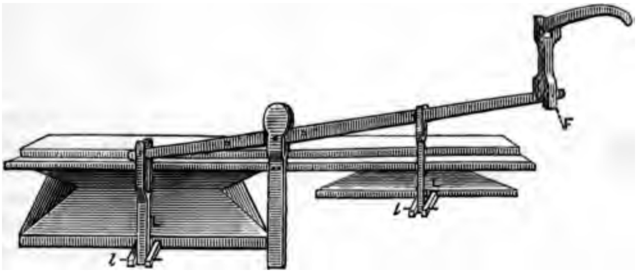

FIG. 10. BELLOWS ACTION.

CHAPTER II.

Anemometer—Wind-trunk and Wind-chest.

In the preceding chapter we had occasion to mention the use of a number of reservoirs to regulate the different *weights of wind.* This expression may require some little explanation. It is obvious that, if wind be admitted to a pipe at a given pressure and produces a given note, that, if the pressure be increased, the note will be sharpened; and it also is clear that many kinds of pipes may require a higher pressure than others, to bring out the best tone of which they may be capable. Thus, to bring out the full effect of an 8ft. reed on a solo manual, would take a far greater pressure than would be required or could be used for a delicate Dulciana or Viol di Gamba on a choir manual. It then becomes a necessity to recognise some standard by which the pressure of wind may be measured. This is found in the Anemometer (Ἄνεμος), which consists of a bent glass tube (Fig. 11), the one end of which is fixed into a socket (s), the other end being left open to the atmosphere. When used, a small quantity of water is poured into the open end (o), which will take the level represented by the shading in Fig. 11. The socket (s) is then placed over one of the holes in the soundboard, which would be occupied by a pipe. On opening the pallet commanding which hole, the wind, under the pressure of the weights of the top board of the bellows, rushes in and depresses the water at D, at the same time raising that at R to a corresponding amount. The oscillation of the water having subsided, the distance between the level on either side D and R can be measured. If the water has risen, say 2in., then the wind is termed a 4in. wind. For the distance between the levels would amount to 4in. The weights on the bellows regulate the amount of rise in the anemometer. The

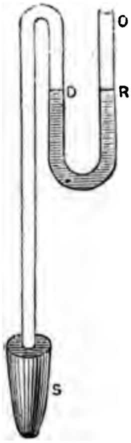

Fig 11. The Anemometer.

approximate weights of wind for the various parts of an ordinary instrument are, roughly speaking, as follow :—

	Inches.		Inches.
Manual portions	2½	to	3
Pedal	3	to	3½
Reeds	5	to	8

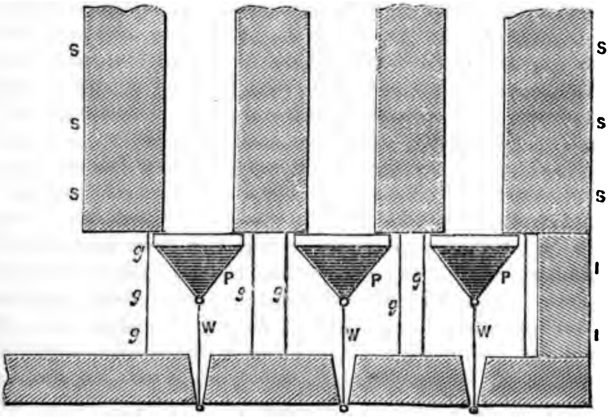

FIG. 12. THE WIND-CHEST (FRONT-BOARD REMOVED).

A solo manual is always heavily winded, rising sometimes in the case of large reeds to 10in.

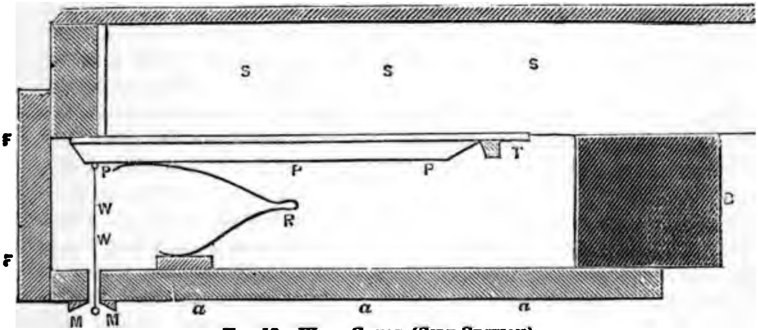

FIG. 13. WIND-CHEST (SIDE SECTION).

We now come to the windtrunk mentioned in the last chapter as having taken origin in the band of the middle-board, from which it proceeds by the most direct route attainable to the wind-chest of whatever organ it may be destined to supply, it being understood that in modern building the great swell, choir, &c., each have a separate wind-trunk to their several wind-chests. The wind-trunk enters the wind-chest either at the bottom (*a a a*, Fig. 13), or at the end (I I, Fig. 12). They are usually made oblong in shape, and are sized in proportion to the number and calibre of the stops they are destined to supply. Naturally, in proportion to the number of stops fed, that of the pedal organ would exceed any other in magnitude. Wind-trunks should be as short as possible, though occasion sometimes necessitates their being lengthy. In any case of an angle that may occur throughout their length, for instance, at their exit from the flange or collar, great care should be exercised with regard to the joint, and the interior should be covered by leather firmly glued over it. Many builders "red size" the wind-trunk all over. The wind is conveyed by the wind-trunk into the *wind-chest*, a section of which is given in Fig. 13 and a front view in Fig. 12.* This wind-chest is a permanent reservoir for the accumulation of wind until it is dispersed into various channels to fulfil its mission. It is placed immediately under the sound board (S S S, Figs. 12 and 13), and extends the whole length of it.† As regards depth, it is usually made slightly deeper than the sound-board. All the portions of the wind-chest should be made most accurately, and glued together. Any false joint in this part of the organ may necessitate immense labour in its rectification, which is sure to become necessary, sooner or later, the error often escaping detection until the instrument has been in use some little time. The wind-chest must also be firmly attached to the sound-board, which forms its upper boundary or ceiling. The back (B, Fig. 13) also must be especially strong, inasmuch as it forms a support to the pipe work above. The front board (F F, Fig. 13) is made movable by means of hooks, or better, by being firmly screwed on. This is done in order that the sound-board pallets (P P P, Figs. 12 and 13), may be easily accessible should they from any cause become deranged, which is sometimes the case. The pallets are ranged along what with them forms the wind-chest, and each pallet has a pull down wire (W W, Figs. 12 and 13) attached to its under surface, which passes through a hole in the bottom of the wind-chest, and communicates with the key action. This hole is made very free as far as the woodwork is concerned, in order that the swelling occasioned by damp may not cause the pallets to remain open, *i.e.*, stick; but, to obviate an escape of wind through these apertures, a thin strip of brass is fastened on the bottom side, and holes made in it to accurately fit the pull-down wires, and the exterior is usually guarded by two wooden beads (M M, Fig. 13).

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* In Fig. 12 the front board is removed.

† The windchest is, strictly speaking, a part of the sound-board, and in the technical language of the workshop, the term sound-board is used for these together. The wind-chest forms what is called the "well" of the sound-board.

The air being stored in the wind-chest is now awaiting its further distribution to the separate pipes, as occasion may require, and this is accomplished by its being passed into a series of channels called grooves, which are in the sound-board, and it thus appears that there should be a groove corresponding to each separate key on the clavier, which is sometimes the case, but there are exceptions ; thus, when a swell only reaches tenor C, it is obvious that it would not require grooves for notes not existing in the swell, and in such a case when these notes do sound at all it is arranged that they shall repeat the octave above, or otherwise act on the lowest octave of some other clavier, in which case an arrangement known as "borrowing" is resorted to, by which, on opening a given groove for which there are no pipes, the wind is conducted to whatever pipes or grooves it is arranged shall be substituted for the wanting octave. Again, these grooves which convey the wind for each note, would require to be larger in the bass than in the treble portions of the organ, inasmuch as the bass pipes require so much more wind ; nevertheless, when the groove would be required very large, it has been found better, for reasons connected with the mechanism in relation to "touch," to substitute two small or ordinary sized ones, thus avoiding the use of a large unwieldy pallet, instead of which two of the usual dimensions are used, one opening slightly after the other, and thus lightening the touch. Under these circumstances there would be more grooves than there are keys to the clavier.

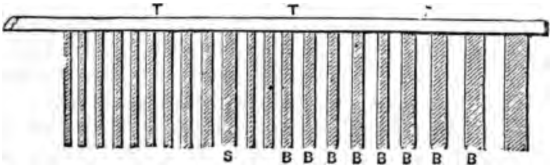

FIG. 14. THE SOUND-BOARD BARS.

These grooves, with their divisions, together with necessary framework, form what is most inappropriately termed the sound-board. Inappropriately, inasmuch as there is no sort of connection between it and the sound produced by the pipes. The sound-board is constructed thus : First a number of pieces of wood, called bars, are planed to the thicknesses required, and then they are firmly glued to what forms eventually the top of the sound-board, technically called the table. This top table (T T T, Fig. 14) being of the right size, and of sufficient strength, is turned so that its under surface is uppermost, and then the sound-board bars are glued in place, to either end of which are also glued small bits of wood, the width the individual groove is to be, of which each bar forms one side—and so on, a bar and these "fittings," as the pieces between are termed, alternately, until the requisite number of grooves or channels has been formed. This done, a narrow piece of wood is glued a little way into each groove, on which is eventually fastened the pallet tail piece. The appearance of the sound-board in this state of advancement would be as seen in Fig. 14 (it being placed in its right position in the cut) where the bars are marked B, and the grooves are left white. The rough edges of the bars being planed, a thick piece of pine or mahogany is glued firmly on the front and back—these are named the sound-board cheeks. The only closing of the bottom of the grooves is a sheet of leather, which is curtailed in breadth, so as not to cover that portion of the grooves which, when in position, is in the wind-chest, and is, consequently, commanded by the pallets. The bars are made of the same length, and are seen to be parallel, but they are thicker in the bass portion than in the treble, that they may the better sustain the pipes above them. When they become thin towards the treble portion, an occasional thick one is interspersed (S, Fig. 14) to add strength as "screw bars." Their thickness varies from ⅓in. to 2in., their length from 2ft. to 5ft., and their depth from 2in. to 6in.

The end or outside bars are made extra stout to enhance the general stability of the sound-board. The grooves, as has been shown, are required larger in the bass than in the treble portion, thus they also gradually increase in width from left to right. If it should be arranged that there are more stops in the treble of the clavier than the bass, or *vice versa*, then the grooves must be made large enough to supply the extra pipes, or else two grooves may be used for each note, as mentioned above. Grooves vary from ⅓in. to 2in. in breadth, from 2ft. to 5ft. in length, and from 2in. to 6in. depth. If these grooves are not made large enough to supply the pipes they are meant to feed, the pipes not speaking their proper tone are said to *rob* each other.

If the reeds are to be on a heavier weight of wind than the flue work, each groove is divided across by a piece of wood, as also is the well of the sound-board. A separate pallet for these divisions being added to every note. If it is desired to have the treble on a heavier wind than the bass, it is necessary to divide the sound-board transversely.

The sound-board being placed in position, part of the grooves (the open portions) lie over the wind-chest, or well of the sound-board.. The wind is commanded in its entrance to these by means of triangular strips of wood, termed pallets, made about ½in. larger than the hole, and hinged at the back with leather, over which hinge, to prevent its giving, is placed a piece of wood termed the "pallet tail piece" (T, Fig. 13) mentioned above. These pallets are commanded by the wire W (Figs. 12 and 13), and, after being pulled down by the key action and released, are replaced over the holes by the action of the spring, R (Fig. 13), slightly assisted perhaps by the force of the compressed wind in the well of the sound-board.

To prevent the pallets slipping on either side, they are guarded by little wires (*g g g g*, Fig. 12), which allow them only room to move freely down and up. The pallets are bedded with leather to make them airtight, and also to prevent noise in action. They are "lightened off" to a triangular form calculated to offer little resistance to the compressed wind when they are pulled by the key action, which is joined to the wires W (Fig. 12), immediately on their exit from the wind-chest.

CHAPTER III.

Sound-board Pallets—The Table—The Upper Boards—Sliders—Bearers—Pipe Rack.

The holes covered by the pallets are necessarily large or small in proportion to the size of the pipes they are the means of supplying with wind. Thus those of the bass would be larger than the treble. The usual length varies from four inches to a foot. In cases of large pedal organs the pallet holes sometimes reach sixteen or eighteen inches in length, but the resistance of the compressed wind on such a surface of pallet is found so considerable a drawback to easy "touch" that they are seldom made more than a foot long. There have been various kinds of pallets introduced to obviate this resistance; among the rest, a *jointed pallet*, by which only the front half was first pulled down by the key action, allowing the wind access round the whole surface of the pallet, doing away with the pressure, and thus instantly releasing the back portion. Perhaps the most simple and ingenious of these peculiar pallets is one termed the *relief pallet* (Fig. 15), and so arranged that it acts like a split pallet, the wind surrounding the bottom half thereof entirely, except at A B C (Fig. 15), so that there is little or no pressure to be overcome on moving this portion, which, being pulled down to the button D, the other half, from A to C, opens by the continuation of

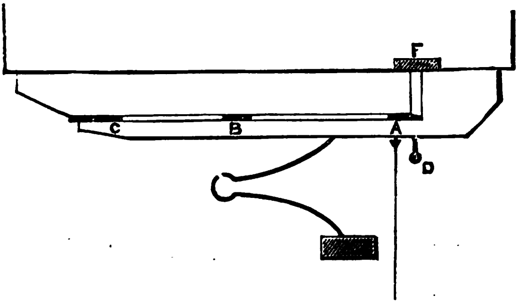

FIG. 15. THE RELIEF PALLET.

the pull-down action. The bit of fitting, F, prevents any wind from escaping into the groove when the pallet is at rest.

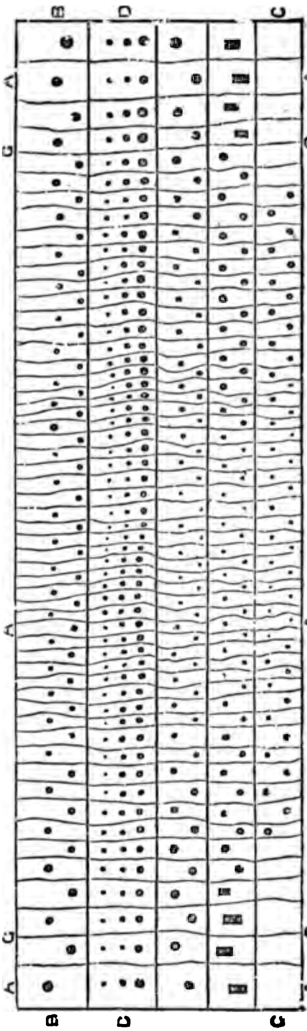

Fig 16. The Table

Thus far arrangements have been made for separating the wind into any groove or grooves it may be desired to fill, and it will be seen that if the pipes are placed over these grooves that, on opening the pallet commanding a given groove, all the pipes over that groove would speak, under which circumstances, were no further means adopted, an organ would always be at its full power, and this was actually the case down to the middle of the fourteenth century, until which period no sort of register was known, the organ being merely a monotonous conglomeration of unisons or one gigantic mixture. Then came the improvement which allowed that each or any row of pipes might be played irrespective of the others. This was effected at first by means of separate pallets for each stop or row of pipes, until a German invented the slide arrangement, which up to the present day has been in vogue. The means whereby this further division of wind is attained, calls into action *the table* (already-mentioned as forming the roof of the sound-board), the *upper boards*, and *the sliders*; and here it should be noticed that although the table would necessarily exist if this command of separate stops was not brought into play, nevertheless its perforations are so modified to help to bring about this result, that it may be naturally looked upon as a part of the mechanism which produces it.

The table being a roof to each and all of the grooves in the sound-board, there are bored over each groove as many holes as there are pipes to be supplied therefrom; in other words, for each stop in the organ a hole appears in each groove; there being exceptions to this rule, as will be presently shown. Fig. 16 shows a table bored for five stops, and, from the distribution of the dots representing the holes, it will be seen that each row *across* (A A) corresponds to a groove in the sound-board; it will also be observed that these holes are more or less in lines *transversely* (B B), each of the longitudinal series corresponding to a distinct stop. These holes are not placed in perfect lines transversely, one being slightly behind the other. This arrangement is merely adopted to economise room, for, if enough space were allowed, the pipes might be laid out in single straight lines, whereas where very limited space only is available, large pipes have sometimes to be crowded into ranks three deep.

When a stop does not *run through*, as in the case of many choir-organ clarionets (alluding to those not met by a bassoon), it would be obvious that no outlet from the grooves over which no pipes were placed would be required. Thus if the 8ft. octave be omitted, the six grooves at either end are left unbored, as seen at C C (Fig. 16); and again if a stop should have more than one pipe to each note, then the longitudinal line would have as many perforations as there were required pipes for each row. Thus a mixture would require three or five holes, according to the number of its ranks; accommodation for a three-rank mixture is shown at D D (Fig. 16). All these holes in the table are of a size in keeping with the pipes they have to supply. Thus the bass portions are larger than the treble, and the 16ft. pipes, requiring more wind than the 8ft. or 4ft., have larger holes under them accordingly. In these, as in all wind passages throughout the organ, it is well to have more room than is actually required for the supply of the pipes in connection therewith, in order always, and under any pressure of circumstances, to have sufficient for their full and competent speech.

It is difficult in describing these portions of an organ to say how great an amount of care should be bestowed upon their construction without appearing to lay an undue stress on each particular part of the whole as it comes under notice. We have already said what accuracy is necessary in the making and putting together of the wind-chest and sound-board; but these being perfect with regard to their bars, grooves, &c., yet another point of equal importance immediately follows in relation to the accurate fitting of the table, on each and all of the bars; for with the slightest defect in this respect, a little wind escapes from the groove, and prevents the pipes of that note from having their proper complement, and at the same time finds its way to a neighbouring groove, where it is not required. The error is guarded against by having little grooves cut on the upper surface of the table, passing between the holes, as shown at G G (Fig. 16), or running mesh-like into each other. If any wind should escape, it is caught by one of these grooves before it can reach a pipe, and conducted to the edge of the sound-board, where it is allowed to escape. Should a bar in the sound-board spring or warp, a running is the consequence, and in such case the only thorough cure is to take the wind-chest to pieces and renovate the defective bar; but sometimes, to save time and labour, resort is had to an operation termed *bleeding*, which consists in boring a hole into the groove through the cheek, thus allowing a small amount of wind to escape, and decreasing the pressure, which would force it through the false passage.

It sometimes will happen that a pallet warps, or from some cause will not bed closely, and the result is a perpetual singing or buzzing into the pipe immediately above. This may not be discernible when the organ is used with all the stops out, as the wind is dispersed into so many channels, but if only a soft stop or so is drawn, it is distinctly audible. The most frequent cause of this defect is that pairings or dust gets between the pallet and its hole. In any case it is necessary to remove the front-board and carefully wipe the face of the pallet, or take it out and alter it, as circumstances may require.

The *upper boards*, when in position, form an exact facsimile of the *table*, and are placed about half an inch or a little less above it. The perforations of the upper-boards are like those of the table, shown in Fig. 16, the great difference between these and the table being that, whereas the latter is in one piece throughout, these consist of several pieces divided transversely into distinct boards, which together form a duplicate in size and appearance to the table—the reason of these divisions is, that in case a slider should warp or become out of order, it may not be necessary to displace *all* the pipes to remove the upper board, and so arrive at the fault. By this it will appear that it would be advisable to have a separate upper board for each stop—and such is best when practicable. We have just stated that the upper boards, when in position, represent a precisely similar appearance as regards the perforations as the table. This is so in theory, and sometimes in practice; but the following cases of exception occur: When there is either not room for the entire sound board, or where sufficient room or height is not attainable for the larger pipes; to meet this emergency they are placed in a suitable position and supplied by means of grooves cut usually in the upper board, or in a kind of *second* upper board called a *groove-board*, these grooves extending from the upper board holes to what ever position may be desirable. But should it be necessary to alter the level of the pipes, then a metal tube is used, called a *conveyance*, which conducts the wind from the groove to the pipe.

The *sliders* and *bearers* go between the upper boards and the table, the former being movable (M M, Fig. 18), and the latter fixed (F F, Fig. 18).

The sliders are long pieces of wood, usually made of mahogany (to insure their not warping), and are pierced with holes, corresponding exactly with those on the table below and the upper board above them. The relations of these portions of an organ will be easily understood by reference to Fig. 17, which shows in section the upper boards (U U), the sliders (S S), and the table (T T), in their several positions. From this it will be seen that a slider can be drawn into such a position that its holes may correspond with those of the table below, and of the upper board above, and thus allow a free passage of wind from the grooves of the sound-board (G G, Fig. 17) to the pipes above (P P, Fig. 17), whereas also it may so be placed by being pushed in, that the holes being moved, its substance effectually prevents the admittance of the wind to the pipes, and this movement communicated by the *draw-stop* action to the slider, is the means employed to command each separate transverse row of pipes or "stop." Thus, then, every slider generally controls a distinct stop, such stop speaking when the slider is "out," and being silent when it is "in." In some cases, however, sliders are divided so that the bass and treble portions may be drawn independently of each other (*Vide* Fig. 47), though in modern organs of large size this practice is not often countenanced. Sliders are from 2in. to 4in. in breadth, and are, of course, of just sufficient thickness to pre-

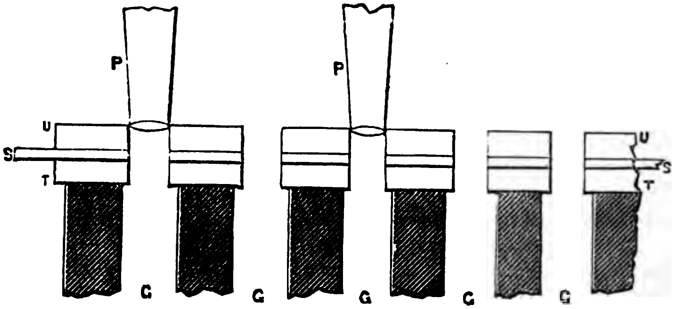

FIG. 17. POSITION OF THE SLIDERS.

cisely fill the space between the upper boards and the table. Any inaccuracy on this point would allow the wind to escape from one note to another. In order to make the sliders move more easily in their confined space, they are usually black-leaded. They are made a few inches longer than the table, so that they may project for communication with the draw-stop action, the lever of which is fixed at one of their extremities. Accuracy of action being essential (to bring the slider holes either directly over and under the corresponding holes of the table and upper boards respectively, or otherwise to effectually displace the holes that no wind be allowed to pass), it is insured by driving a strong pin into the table, and having a kind of loop cut in the slider, in which this pin is embraced. This arrangement is shown in Fig. 19.

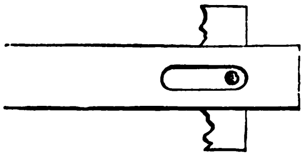

Fig. 19. Slider Guide.

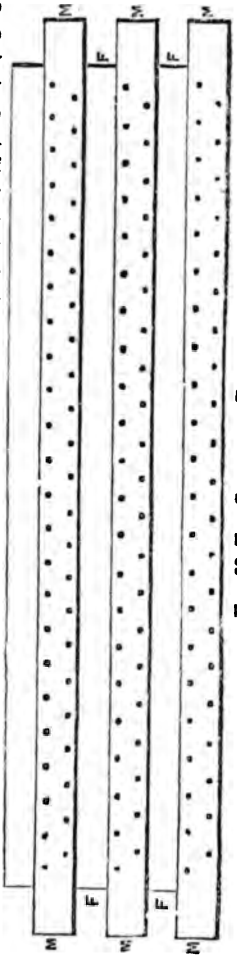

Fig. 18. The Sliders and Bearers.

The bearers (F F, Fig. 18) are strips of wood fixed between the sliders, which not only keep these in position, but also support the weight of the upper boards, pipes, &c., and thus allow the sliders full action.

The *Rack-boards*, as their name indicates, are frames by which the pipes are supported in a perpendicular position over the upper boards. A sketch of an ordinary rack-board is given in Fig. 20. They are usually made of pine, and their thickness is decided by the size of the pipes they are required to sustain in place. Rack-boards (B B, Fig. 20) are usually from 4in. to 6in. above the upper boards, and are supported by *rack-pillars* (P P, Fig. 20). Holes are bored in the rack-boards immediately over those of the upper boards, and of such a size as to fit tightly round the pipes they hold, and thus the pipes are kept in place. In order that the tips of the pipes may not slip from position on the upper boards, the holes in the latter are slightly sunk. It may be broadly asserted that, with the exception of very large metal and wood pipes, all the pipes are racked in this manner, the boots of the reeds taking the place of the tips of the flue-pipes.

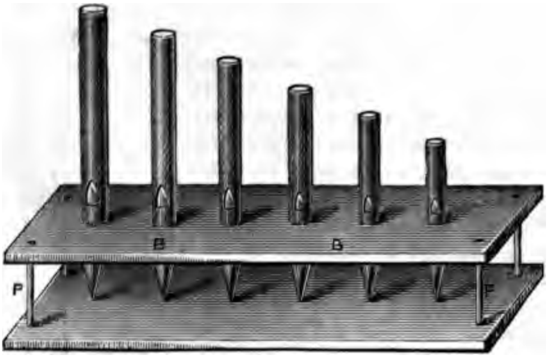

FIG. 20. THE RACK-BOARDS.

CHAPTER IV.

Distribution of Grooves, Pipes, and Stops.

THE position assumed by the various pipes in a stop or stops in an organ, with regard to their size, is a matter of importance from more than one point of view. It is obvious that where there are the large grooves there also are the large pipes, and, again, that it may be so arranged that large or small grooves come in any part of the sound-board indifferently; therefore, in considering what is their most convenient situation, the idiosyncracies of the individual instrument must be taken into account, and due weight given to the room, number of pipes to be "in sight," or in the front, &c. Naturally, the most important considerations are simplicity of key action and easy access to any pipes for tuning.

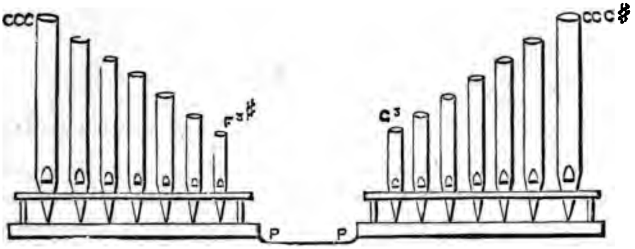

FIG. 21. TONAL ARRANGEMENT OF PIPES FOR GREAT AND CHOIR ORGANS.

In accordance with these views four distinct plans have been adopted: In the first of which, usually applied to the "great" and "choir" departments of ordinary organs, the grooves, and therefore the pipes, assume an alternate relationship, so as to bring the larger pipes on either side and the smaller in the middle, a passage-board for the use of the tuner generally being placed in the centre, dividing the sound-board into two distinct halves. According to this arrangement the pipes would appear as seen in Fig. 21, with the CCC to the extreme left and the C C C sharp to the extreme right, and on either side of the passage-board (P P) would be the F^3 sharp (on the C C C side), and the G^3. (on the C C C sharp side).* The advantage of this distribution is that a tuner standing on the passage-board, can not only reach easily the smaller pipes but also those of moderate size, without displacing any others. It must be borne in mind that the small flue pipes require much more frequent attention than those of larger calibre, hence the desirability of easy access. In speaking of either of these divisions of the sound-board on either side the passage-board, each half is known by the name of the lowest pipe contained therein; thus we speak of the C C C side or the C C C sharp side, the G G G side, or the G G G sharp side, as the case may be.

The next plan is a direct reversal of the one just explained. Here the largest grooves are placed nearest each other, and the two smallest at either end of the sound-board, as seen in Fig. 22. This scheme is

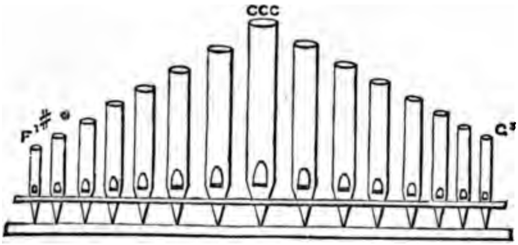

FIG. 22. TONAL ARRANGEMENT OF PIPES FOR ORGANS WITH LIMITED SPACE.

extremely useful for "swells," where there is not room for a passage board, for on the sides of the swell box being removed (they usually being buttoned or hooked to allow of easy displacement), the tuner finds himself in precisely the same position as regards the pipes of the side on which he stands, as though he stood on the passage-board of the former arrangement (Fig. 21), except in the case of "laying the bearings" on the principal, for then he would be obliged to go from side to side of the organ to command the requisite notes.

These two designs are both "tonal" in their distributions—*i.e.*, starting from either side and going from pipe to pipe, each one is a tone higher or lower as the case may be, than its neighbour.

In the third plan every groove as far as tenor C is arranged chromatically—*i.e.*, each pipe is a semitone lower than its neighbour (going from left to right). After tenor c the lower octave proceeds as in the first plan, alternately from side to side. The position the pipes assume is shown in Fig. 23. This system is adopted in small organs as requiring a simpler key action than the two former.

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* Figs. 21, 22, 23, 24, and 25 are merely diagramatic, and show only the position of the pipes or stops referred to, without giving the actual number.

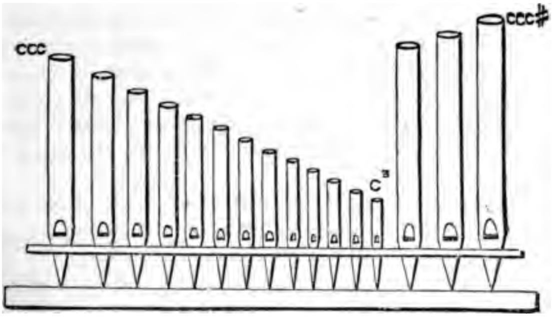

FIG. 23. CHROMATIC ARRANGEMENT OF PIPES FOR SMALL ORGANS.

The fourth plan (Fig. 24) is one in which the grooves are placed chromatically throughout their entire compass; this scheme requiring the most simple key action, is used by many foreign and some English builders.

These several plans of diffusion, of course, have all their advocates and opponents, and therefore perhaps it may be as well to point out the general characteristics and advantages of each.

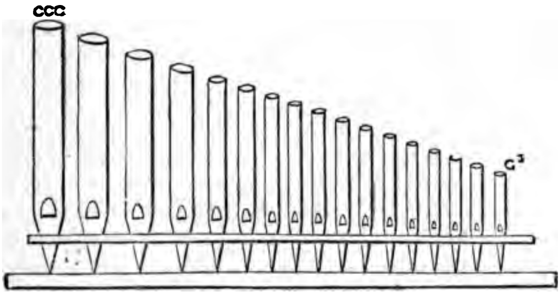

FIG. 24. CHROMATIC ARRANGEMENT OF PIPES FOR SMALL ORGANS.

There is much to be said in favour of the first plan. Passage boards are always useful and convenient in an organ, not only as a means of access for tuning, but also that any of the adjacent surroundings may be easily examined without danger to the pipes. Again, the space they occupy opens a means of free egress for the tone, and thus adds much to the general effect. It has already been observed how necessary it is to have the smaller pipes under control; but another point in this system is the division of weight evenly throughout the organ, all the heavy pipes are not crowded into one side, and therefore the strain is more even and less likely to injure the work beneath by undue pressure.

The second plan being so much more compact for swells, and where space is valuable, is chiefly used for this department, or small organs, so that we may dismiss it as being of a character not likely to interfere with the others.

The third plan, again, has the advantage of equal distribution of weight, and this being used chiefly for organs too small to require passage boards, has its sphere of utility independently of the others.

Of the fourth plan there is more to be said. Its advocates argue for it simplicity, and with truth. To which its opponents answer that all the weight of the heavier pipes is on one side of the organ, and also that the consumption of wind is also unevenly balanced; these statements being met by the fact that weight can be borne if properly calculated in the building of the supporting portions, and that by proper arrangements wind can be supplied in any amount required; but the serious defect of this arrangement is, that the notes *draw*, that is, if one pipe is placed next to its semitone it is found that the pitch is influenced by this proximity, thus: If CC is out of tune it can be tuned by altering the condition of CC sharp, its immediate neighbour. This occurs so much in the lower and larger pipes that it has almost entirely prevented the adoption of this plan among the higher class of builders, except for small chamber work.

In this plan pipes are not often placed off their grooves, and so conveyances, with their necessary anxieties, such as leakage, &c., are avoided, and, the grooves standing in a direct semi-tonal relationship from right to left, the action of the keyboards is simplified, no rollers being necessary. Therefore, in small organs where neither the pneumatic nor electric actions are brought to bear, the touch is lighter and more immediately responsive.

It is difficult to assert which of these is the best arrangement, inasmuch as so many bearings arise in each individual case that in others would be absent, though it may be fairly said that for large instruments the first is usually adopted.

Having seen how the grooves and pipes may be placed with regard to their relative sizes, it next becomes necessary clearly to understand the position of each "stop" in its relation to its fellows, and this is best understood by reference to a sectional diagram, as represented in Fig. 25, which gives a view of a "great" and "choir" organ.

This demonstrates that a passage-board (W), divides these departments, and that the stops in either are so distributed as to come within easy reach of the tuner. In the diagram, the letters from A to H represent the following stops of the great organ respectively:—(A) open diapason, (B) gamba, (C) stopped diapason, (D) harmonic flute, (E) principal, (F) fifteenth, (G) mixture, (H) trumpet. The letters from K to O represent the stops of the choir organ—viz., (K) the clarionet, (L) piccolo, (M), principal. (N) stopped diapason, and (O) open diapason. A tuner therefore, standing on the passage-board, W, would be able to reach easily any stop requiring attention. The reeds being most often out of tune are placed immediately next the passage-board; then the flue stops are arranged in more or less direct relationship to their sizes, placing the larger at a distance, and the smaller nearer.

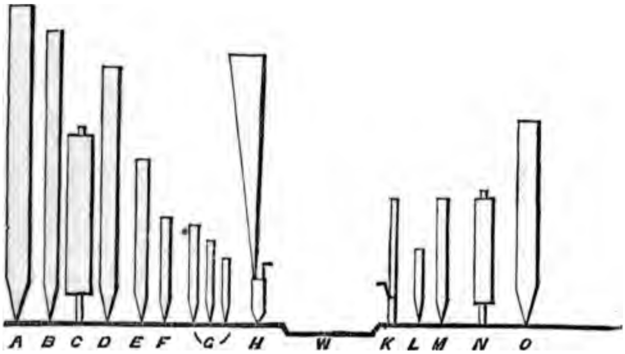

FIG. 25. SECTIONAL VIEW OF THE PIPES OF GREAT AND CHOIR ORGANS.

The same distribution holds good with regard to the pedal organ for similar reasons, and the swell is always arranged with the reeds outside, their tubes being narrower at the bottom, and giving vent for the sound of the other work. Again, the removal of a single shutter or board of the swell places them within reach of the reed-knife.

CHAPTER V.

Various Actions briefly reviewed.

WHEN commencing the subject of construction we mentioned the principal divisions of an organ as those parts which produce or command sound, and collect, retain, or distribute wind. But as media between these come the various actions which place the different portions of an organ immediately under the control of the performer. First in importance stands the key action, which consists of a complication of mechanism between the keyboard and the pallets of the sound-board, each separate key being in direct and independent relationship to its particular pallet, commanding thus the groove which represents its individual note in the scale. Analogous to this action comes that which plays the same part in connection with the pedals.

It will not be possible in a limited work of this description to describe every kind of action which has from time to time found favour, or even all those now in use. Each builder of note has a more or less distinct mode of communication to which he usually adheres. We therefore shall confine ourselves first to the principles on which all such actions are based; and, secondly, to describing those methods which, at any rate, are up to the standard of the present day.

In the action department of organ building, improvements of more or less importance are always appearing, and as each instrument is made so it is often necessary to adopt individual peculiarities in this part of its construction. But, on the other hand, within the last few years two great steps have been made which have completely revolutionised many of the old notions on which actions were planned. Naturally the great consideration would be *touch*, and if in a large organ, where the swell was high up or far off, or in an instrument divided into two portions, the action from the keys to the pallets was long, complicated, and heavy, the touch suffered in proportion, and in some cases when the various manuals were *coupled*, it became a matter of strength as well as musical skill to play the instrument. All this has been met by the *Pneumatic* and *Electric* actions, and it is now rare indeed that any organ of importance is built without the aid of one, if not both, of these. The former is used in ordinary organs to lighten the touch of the several or combined manuals, whereas, by means of the latter action any distance can be spanned, and the touch made to answer as easily and precisely as if the manual were under the very pipes. It therefore will be necessary to describe these Pneumatic and Electric actions somewhat in detail after having made clear the ordinary systems used in small organs, or where the above-mentioned are not required. In the formation of a key action *backfalls* or *levers*, *squares*, *rollers*, *trackers*, and *stickers* are chiefly used, and will be severally described.

The pneumatic action is an ingenious arrangement by which the bulk of the pressure is taken from the key, by means of small *power-bellows*. There are as many of these power-bellows as there are keys to the clavier, and instead of the key acting on the sound-board pallet, it acts on a small and light valve which admits compressed air into the power-bellows, the which, being previously collapsed, now expands with great rapidity, opening at the same time the pallet to which it is connected. This remains open until the key is raised, which action closes the valve which admitted the air into the power-bellows, and opens another for its escape. The bellows then collapse, and the force of the usual spring closes the pallet.

Coming to the mechanism between the draw-knobs and the slider, which commands the stops, and is termed the *draw-stop* action, much may be said of it that has been observed of the key-action. There are different modes in use by various builders, and in its usual forms it includes *trundles* or *rollers*, *squares*, and *connecting-rods*, naturally much stouter than the corresponding portions of a key action. The pneumatic action has been introduced into this department also, with great advantage.

The arrangement by which the command of a given combination of stops has been obtained, by the use of a pedal or button, has given rise to a distinct mechanism, which has likewise been much assisted by the pneumatic arrangement.

The manner in which all or any of the various manuals can be coupled to each other or the pedals, has again necessitated a separate action. To this list may be added the *Sforzando-pedal* action and the *tremulant*, which latter, perhaps, is hardly on an equal footing with the former, as being less complicated in its construction.

Before entering into any detailed account of any of these actions it is necessary that we say a little with regard to their application. We have said that the pneumatic and electric arrangements have come prominently to the fore, and now enter into the composition of almost all important instruments, but we by no means wish it to be inferred that therefore all organs of good character should contain one or both of these arrangements. It may and does frequently happen that the introduction of these actions are mere complications of an expensive character, adding little or nothing to the value or beauty of the instrument. Being invaluable as a means of lightening touch, or heavy actions; in a chamber or small sized organ they may be useless, and better absent. In large instruments, which are of necessity under the immediate care of a builder and regular tuner, the pneumatic or electric actions are in their proper place; but imagine an organ of small size in the depths of the country, with, say, fifty-six extra power bellows or two galvanic batteries requiring attention. Simplicity in every possible direction should be the constant aim of every mechanic, and, therefore, of all organ builders. Never sacrifice a touch for the sake of the extra cost of pneumatic or any scheme, but be careful never to insert an extra source of possible error in constructing an instrument. As we have said before, each case must have its individualities. It often occurs that the pneumatic is a necessary addition to the great organ or swell action without involving all the manuals. We would say that it is better to be guided by the advice of a good builder where there is any doubt. As regards the electric action, here again circumstances must decide. It may be far more to the purpose to have the manuals at one end of a drawing room or hall, and the organ at the other—here is the place for this action. It is convenient that the organ and orchestra go together in an opera, but inconvenient that the former be in sight; therefore, in our opera houses the electric action found an immediate and cordial reception.

All action should be made with scrupulous accuracy and finish, and as we describe each we shall enter more fully into the various details regarding them, and the means employed for obviating noise; but before going into any particulars of the many actions essential or complemental to an organ, let us once more point out that simplicity is here the talisman that should guide alike the professed builder and the amateur.

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CHAPTER VI.

The Claviers and Key Movement—Key Action—Trackers—Stickers—Backfalls—Rollers—Squares.

THERE appears sometimes to be a little clumsiness portrayed in the jumble of terms used indiscriminately to define any or all the key boards, a word, therefore, relating to nomenclature may be useful, and save future misunderstanding.

The word *clavier*, coming to us through the French, is derived from the Latin[*] *clavis, a key*, and is used to define any keyboard whatever, whether played by the hands or feet, it being understood that a keyboard is a collection of keys (levers) definitely arranged, by the means whereof the organ is played.

Those keyboards under the control of the hands are termed *manuals* (*manus*, a hand), and those played by the feet are called *pedals* (*pes*, a foot). The term *consol*, or the French form *console*, is used in referring to the complete claviers, draw-knobs, &c., when set up separately at a distance from the body of the instrument, as in the case of lengthy actions, or more particularly where the electric action is used.

There may be from one to four, or even more, manual claviers to an organ, though there is usually only one pedal clavier. Where there is more than one manual, they are always placed so that the lowest is the most prominent or nearest the performer, and the highest the most distant. As a general rule each clavier commands a distinct portion of the instrument, the usual arrangement being that in two manual instruments the swell manual should be above that of the great organ, and in cases of three manuals that of the choir is, as a rule placed below that of the great organ. The fourth manual is generally for a solo organ, and is immediately above the swell. These positions are not invariable, and, as an instance of deviation, may be mentioned Mr. Holmes' large instrument; here the order being great, choir, swell, solo, from below upwards.

It is sometimes advisable that two departments of an organ should be commanded by a single clavier, and thus avoid the necessity for perhaps five distinct manuals—a good instance of which arrangement may be seen in the organ of All Saints, Northampton, where the choir, organ, and echo swell, are each played from one keyboard, a special register transferring the wind from one to the other set of pipes, as occasion may require. Again, in Mr. Holmes' organ the echo, the solo, and the carillon are all three commanded from the fourth or uppermost clavier.

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[*] Clavis again being obviously from the Greek κλείς.

The first keys were of such rude construction that they were beaten with the fist (Chap. I.); and it was not until the introduction of sliders, and therefore the discontinuance of separate pallets for each stop, that they were made sufficiently light to be commanded by the finger. In the days of Father Smith and Renatus Harris, the keys having assumed the shape and order which we still retain, the claviers were not so wide as those of the present day. These raised notes were made shorter that the fingers might the more easily pass under the palm of the hand, it being then unusual to use the thumb in playing, which hung useless in front of the keys. Sebastian Bach introduced the modern style of execution, and the keys were made longer, and in Snetzler's organs they are much the same width as those of modern manufacture. The appearance of the keys, as illustrated in the pianoforte, is too well known to require description; though it may be interesting to note that the first sets were made with the raised notes white and the naturals black, an instance of which is curiously retained at Exeter Cathedral (Chap. II.).

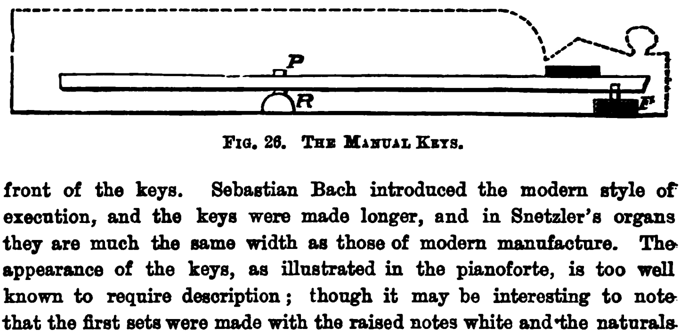

FIG. 26. THE MANUAL KEYS.

The manual keys are generally made of pine bushed with limewood, with the surfaces ordinarily in view, capped with ivory in the case of the naturals, and ebony in the case of the raised notes. Each key is hung on a pin (P, Fig. 26) that is inserted in a *ballance-rail* (R, Fig. 26), which latter runs the whole length of the clavier. This pin is not placed quite in the centre of the key, but slightly back, leaving about five-ninths of the key in front. Another pin passes into the front part of each key, but not right through. This second pin rises from a *front rail* (F, Fig. 26), and allows the key to fall evenly and steadily under the finger. The front pin is *bushed* by two or three thicknesses of baize, in order to avoid rattling.

The front and back *rails* (F and B, Fig. 26) are fixed into *key-checks*, which bound the manuals on either side, indicated by a dotted line in Fig. 26.

In order to prevent the weight of the action forcing the keys too high on the removal of the finger, a *Thumping-board* is placed just behind the beading or board which bounds the usually visible portion of the manual. This consists of a strip of wood heavily weighted with lead. This is also bushed with felt or baize to prevent noise.

The pedal keys are made usually of mahogany, red pine, or birch, and are of course much larger than the manual keys. There are usually two octaves and a half or five-eighths to a complete pedal clavier. A glance at Fig. 27 will show the principle on which these are constructed. The key works on a pivot (P), and when pressed by the foot descends at D. The spring (S) causes the key to resume its position when released.

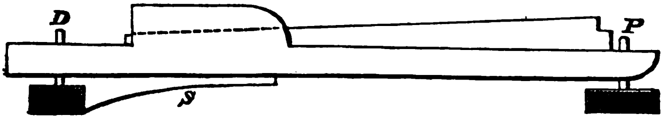

FIG. 27. THE PEDAL KEYS.

The pedals are placed at a convenient distance under the manuals, that they may be easily reached by the feet.

It unfortunately happens that pedals are not made of one invariable size, shape, and width, so that it frequently occurs that a first-rate performer is at sea on a strange instrument on this account.

The first pedals used in Germany were small, short, and perfectly straight under the performer; they extended only for an octave, and having no separate organ of their own, merely pulled down the corresponding manual keys.

After being extended, and having separate stops allotted to them, they became of more importance, and were of about two octaves or two octaves and a quarter in length; and the saving of space being considered an object, the *radiating* or fan-shaped pedals were invented, by which means the back part of the keys were of the usual width, or nearly so, whereas the front portion, which would not be touched by the feet, were contracted into as narrow a space as possible. They were also made *concave* as well as radiating, and thus it comes about that even though all modern instruments are of the same pedal compass—or, at any rate, the same extent downwards—that, nevertheless, the actual position of a given note alters just enough to put a player out if he be using that variety to which he is not accustomed.

After lengthened trial, it seems doubtful if the concave radiating pedals are much superior to the straight. Opinions differ. We should be inclined to advocate a slight radiation, though it is greatly to be deplored that one definite plan has not been adopted and adhered to by all builders.

The position of the clavier in relation to the body of the instrument is a matter of great variation. Where there is space, and no reason for the contrary, it is always better that the manuals should be in the front of the organ immediately under the impost; but, as is frequently the case, there is a want of space, or some other reason which necessitates the claviers being placed at the side or even the back of the instrument. It often happens also that the claviers are not incorporated with the body of the instrument at all, in which case a *long movement*, as it is called, is brought into use, unless, as is now possible, the electric action be employed. It is sometimes desirable that an organist should be among his choir at a little distance from his instrument, as at M. Cavaille Coll's organ at Kensington. Many instances of long movements crop up, a gallery organ frequently being divided to admit the light of a window, as at the Pro-Cathedral, or St. Anne's Roman Catholic Church, Spitalfields. The electric action has made the distant position of the claviers a matter of such indifference that long movements must gradually secede and give place to their great rival. The position of the consol at St. Michael's, Cornhill, is typical, the organ being at one side of the church and the claviers at the other, with the choir between them.

The organs of the opera houses have been mentioned in a previous chapter, but while alluding to *long movements*, and the position of the performer with regard to his instrument or parts thereof, we would point out a most quaint passage by M. Gretry in his "Essai sur la Musique." It is of great interest, as showing the desire, almost the prophetic vision, of better things ; and though published as late as 1788, it would appear that Jordan's invention of the swell had not then reached Paris :

> Le bâton de mesure est cependant nécessaire au théâtre de L'Opéra, ou souvent dans la coulisse, on exécute de grands chœurs, quand la situation dramatique l'exige. Il ne faut pas croire qu'un grouppe de chanteurs ainsi éloigné puisse entendre l'orchestre, quelque nombreux qu'il soit : chacun chante à l'oreille de son voisin, et je me suis quelque fois surpris chantant contre mesure et conduisant à faux le chœur qui m'environnoit. Le maître des chœurs peut s'avancer et jetter un coup d'œil sur le bâton, direz-vous ; c'est ce qu'il fait ; mais si c'est un chœur dansé et chanté ; si une foule de danseurs occupent l'avant-scène, le bâton n'est plus visible. Le batteur de mesure frappe alors sur son pupître ; ce qui est très désagréable à entendre, car il vous rappelle sur-le-

> hamp que vous êtes à la comédie. J'ai souvent songé aux moyens de remédier à cet inconvénient; je crois qu'on le pourroit, en plaçant quelques gros tuyaux d'orgues derrière la scène, ou sous le théâtre même, en ouvrant le plancher par des trous aux endroits des tuyaux: le clavier seroit dans l'orchestre, un organiste y toucheroit pour accompagner, guider les chœurs et les empêcher de sortir du ton. D'ailleurs ces excellentes basses de vingt-quatre pieds, en renforçant l'harmonie, ajouteroient singulièrement à l'effet. L'on cherche les moyens de diriger les aérostats, cherchons donc aussi à perfectionner le plus beau, le plus noble instrument de musique que nous ayons. L'orgue en effet seriot à lui seul un orchestre superbe si l'on pouvoit donner au son la gradation du doux au fort, à volonté de l'organiste. J'en ai parlé à M. Charles, et il n'a pas cru cette découverte impossible; c'est lui ai-je dit, l'étude de l'organe humain qui plut vous y conduire. La manière dont nous formons les sons, le developpement ou le retrecissement que nous observons naturellement pour nuancer le chant, la manière dont un joueur d'instrument à vent modifie les sous par les mouvemens des lèvres et le ménagement de souffle, &c. Sont ce qu'il faut approfondir et imiter pour y parvenir.

It may be noted that M. Gretry's difficulty has been met by a mechanical arrangement, by which a baton behind the scenes, for the use of an invisible chorus, is commanded by the conductor's foot from his seat in the orchestra.

The communication between the keys and the pallets is usually effected by means of an action, which, though differing in detail in various instruments, may always be classed as belonging to one of two great divisions—viz., the *fan-frame* movement or the *roller-board* movement.

The more simple is the *fan-frame* movement, the essential parts of which are a *sticker*, a *back-fall*, and a *tracker* severally. In Fig. 28 this arrangement is shown in its simplest and ordinary form, A K representing a key, on the back end of which rests the sticker S, on the near end of which again rests one end of the backfall B, which, being balanced by a centre pin, acts on the tracker T, which is attached by one end to the backfall, and at the other to the pull down of the pallet P.

Stickers are usually made of pine, and are either round or square, generally the former, their length varying according to circumstances, from a few inches to 2ft. or so. From the top of each sticker a pin runs into a hole through the front end of the backfall, in order to prevent any slipping or displacement. The contact of the sticker and backfall is bushed by baize, in order to prevent noise when the latter falls after action. Stickers are sometimes made to pass through a register or frame, so that they are less liable to become displaced, and by means of a collar placed above this frame any key, or even the whole set, may be moved without moving the stickers also. The collar also prevents their rattling together.

Backfalls are usually made of mahogany, sometimes of oak, or any hard wood, and are of the shape indicated in Fig. 29. These, again, vary in length, according to circumstances, from 6in. to several feet. They are kept in position by a *backfall-frame* (F), which is a beam so cut as to receive them, and are hung on a rod of brass, which is fastened to the frame on their either side by small staples.

The *trackers* (Fig. 30), are long flat strips of pine about ¼in. wide and ⅛in. thick. At the lower end of the tracker is fixed a wire, which has a screw thread, on which runs a button of leather for the accurate adjustment of the tracker to the backfall (S, Fig. 30). The upper end is provided with a loop of copper wire for communication with the pull down of the pallet (C, Fig. 30,). The wire at the lower end of the tracker is fixed by means of a slight hook at the upper end, being driven into or through the tracker, and the wire being bound firmly in place by strong thread, which is afterwards sized to keep it from coming undone.

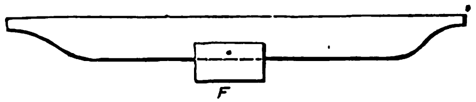

FIG. 29. THE BACKFALL.

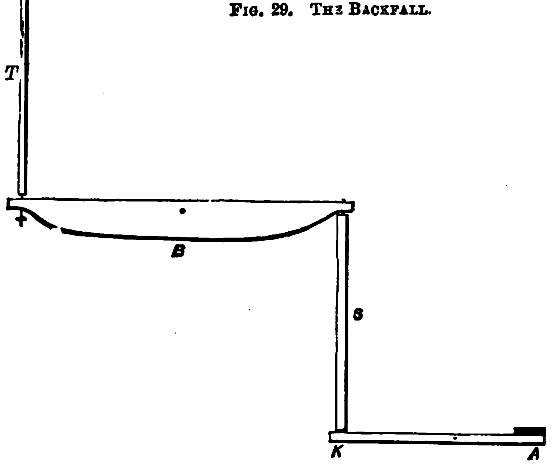

FIG. 28. THE FAN-FRAME MOVEMENT.

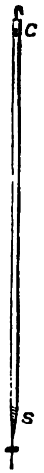

FIG. 30. THE TRACKER.

The action of the *fan frame* movement is obvious; on pressing the key at A (Fig. 28), the end K rises and lifts the sticker S, which depresses the opposite end of the backfall B, and thus by means of the regulated position of the leather button, pulls down the tracker T, which is attached to the pallet pull down.

By this action each key communicates more or less directly with its corresponding pallet, but the key-board and grooves being parallel, it occurs that the sound board grooves, being wider than the separate keys of the clavier, that the movement could not assume parallel and direct lines from the one to the other, but that as they approached the ends they would be spread out and assume a more or less fan shape, according to the difference between the length of the sound board and that of the clavier; hence the title *fan* frame is connected with this kind of movement. It will be apparent that this simple mechanism can only be used for the third or fourth plans of arrangement (*ante*, Figs. 23 and 24), where the grooves of the sound board are distributed chromatically; and that even in the third plan exception must be taken for the lower octave, which is in this arrangement semi-tonal, to meet which contingency a roller is used, by which means each tracker is brought under its proper pallet.*

Fig. 31 shows an ordinary roller (R R), which is fixed by means of two holders, called studs (H H), into the roller-board or frame (F F). The roller revolves on the centre pin, which is seen passing through the studs in the figure. At either end is placed a roller arm (A A), one end of which is immediately over the tail of the key, and the other directly under the front end of the backfall. These arms are connected by means of stickers to the keys and backfalls respectively. On the key being pressed the roller raises the end of the backfall, which pulls down the pallet in the ordinary manner.

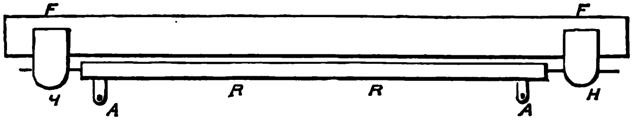

FIG. 31. THE ROLLER.

Rollers are arranged under each other in sets, and are now made of iron tubing, in lieu of the old fashioned wood, which was found to take too much room, and to be more liable to change. Each arm of the roller is well bushed to prevent any noise in action.

The *roller movement*, as the name would imply, requires a number of rollers in its construction. It is clear that in the arrangement of the grooves of the sound-board in the first plan (Fig. 21), which is the usual arrangement for large instruments, that whereas the C C and C C sharp keys are, of course, side by side, that their respective pipes would be at opposite ends of the soundboard; and in going through the scale in this plan this alternation continues. This difficulty is met by placing the backfalls *parallel* with each other, and bringing each under its individual pallet by means of a separate roller (as just described in the lower octaves of the third plan, where the fan-frame movement is used). This necessitates a great number of rollers, which are fixed in a frame and closely packed in layers. This frame is placed immediately under the wind chest, and extends almost the whole width of the sound-board. A glance at this action in an organ already built, will at once render its construction and action clear.

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* Seeing that in this third plan all the keys of the bass octave are to be left in their usual position, whereas the alternate notes, six at least, are on the opposite side of the sound-board, these six or more keys would be quite away from the actual pallets they had to act on.

When the sound-board is too far back for the ordinary key action just described to reach conveniently, as in the case of choir organs or swells, a modification of the whole action takes place. Backfalls are dispensed with, and *squares* inserted in their stead. These squares (Fig. 32) are centres made of wood, with two arms (A B) about 3in. long (these latter being occasionally of metal), the angle of the squares is let into a *square frame* (F F), and is hung on a metal rod, on which it can easily move in either direction. Squares should never be made in a solid piece, but by the junction of two distinct parts at least, as if made in the solid they are liable to give way with the strain, on whichever arm is cross-grained. The sticker acts on one end of the square, and to the other is fixed a tracker, which communicates with the rollers, varying in length, being 12ft., 14ft., 20ft., or even 60ft. in length. When made so very long, they are supported at various places throughout their length by bridges, which also prevent their becoming lax or intermingled. A square can transmit motion round any corner like an ordinary bell crank. This action, therefore, can by arrangement be made to meet almost any requirement.

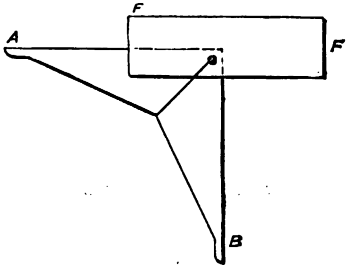

FIG. 32. THE SQUARE.

CHAPTER VII.

The Pneumatic Action and Pneumatic Pallet.

In Chapter V. we gave an idea of what the pneumatic action consisted—viz., an intermediate apparatus, which, being brought easily into action itself, had the power of doing a far greater amount of work than could with fairness be expected of the unassisted performer on the ordinary work, this holding good not only as regards its application to key action alone, but also with regard to draw-stop and other mechanisms.

Before describing this most useful and interesting attribute to our larger instruments, it will be in keeping to give briefly a few facts concerning its birth and history. Like many of our great inventions, there are several who lay claim to its original discovery, and again, like other inventions, it was not born in the flush of full-blown perfection; but, coming as an imperfected representation of a sound theory, has since been assiduously studied by those interested in its progress, and, being improved from time to time, has now reached a point at which it may fairly be said to answer present requirements as nearly as can be in reason desired.

The first attempts at relieving weight in action by means of small bellows were made simultaneously in 1827 by Mr. Joseph Booth, of Wakefield, an organ builder of some repute, on the one hand, and by Sebastian Erard on the other. Booth named his arrangements "*puff valves,*" and Erard exhibited his "*light touch valve*" at Paris, in 1830. But in the same year Mr. Barker and Mr. David Hamilton, of Edinburgh, brought out independently of each other a pneumatic action, more nearly resembling those now in use; the latter gentleman reading a paper on his invention before the British Association, 1836.

Mr. Barker wrote to Dr. Camidge, then organist of York Minster, asking permission to apply his invention, in a temporary manner, to one of the heaviest keys of that large organ. Dr. Camidge encouraged the idea, and complained of the serious labour of playing on so large an instrument with all the manuals at full power and coupled. Unfortunately, the pecuniary question prevented its adoption in this instance, and he was not more successful in his proposition for its application to the Birmingham Town Hall organ opened in 1835.

In 1837 M. Cavaille, of Paris, was building a large instrument for the royal church of St. Denis, and the touch was so heavy that it seemed doubtful whether any organist of repute could be found who would hazard his reputation by attempting such difficult manipulation as would be necessary. Mr. Barker wrote to M. Cavaille, who at once jumped at the idea, and it was arranged that the former should himself superintend the construction of the mechanism in this instrument, for which purpose he went to Paris. He took out a French patent in 1839, and had the satisfaction of finding that the application of his invention was a complete success in this the first important trial thereof. After having this action introduced into several of the largest and best known Parisian organs, Mr. Barker joined the company of MM. Doublaine and Callinet, and his invention was frequently in request for their larger instruments. This company being dissolved in 1845, Mr. Barker carried on the business for M. Ducroquet, a capitalist, who had purchased the goodwill of the late company, and built for him many important instruments, prominently among which stands that of St. Eustache, and also the small but complete organ which appeared in the French department of the Great Exhibition of 1851, and for which M. Ducroquet received, in addition to the English prize medal, his nomination as *Chevalier of the Legion of Honour.*

There were in this exhibition two other organs with the pneumatic action, one by Mr. Willis, which also applied the invention to the drawstop action; and one by Mr. Hill, the latter applying the pneumatic arrangement to the drawstop mechanism only. From this date English builders began to appreciate the advantages to be derived from the pneumatic system, and mechanics from Paris were found in the English workshops, so that when Mr. Barker proposed to take out an English patent he found he had been forestalled.

In the Paris Exhibition of 1855 Mr. Barker was admitted as an exhibitor on his own account, and independently of M. Ducroquet, who was at that time retiring from business, but for whom he had built as a final specimen for this exhibition an organ of twenty stops, having three manuals and a separate pedal organ. In this instrument the pneumatic action was turned to good account, for it enabled Mr. Barker to place all the powerful reeds of the great organ in a swell-box, and thus obtain an unusually effective *crescendo.* At the close of this Exhibition Mr. Barker obtained a first-class prize medal, and was nominated *Chevalier of the Legion of Honour.* Figure 33 is a section of a single application of this invention as used in manual key actions. The lowest chamber on the right (*a a*) contains highly compressed air derived from a reservoir, the lever *l l* carrying the valve *v*, which cuts off the communication between this chamber and the one immediately above it, works through an air-tight leather joint (*b b*) in the centre, the left-hand end of the lever moves the double exhaust valves *e e*, and is attached to the extremity by a tracker (*t*) to the tail of the key. On raising this end of the lever *l l*, the valve *v* is opened, admitting the pressure from the chamber *a a* to the chamber immediately above, and thence to the interior of the power bellows *p p p*, which thus become inflated; simultaneously the exhaust valves *e e* are closed, and prevent the exit of the compressed wind, as the top-board of the power bellows rises it draws up the throttle valve *x x*, which is attached to it, so that on this valve's reaching the seat provided for it, it cuts off any further supply of compressed air to the power bellows, and thus checks their motion almost noiselessly. The movement of the top board of the power bellows is communicated to the sound board pallets by the usual train of mechanism. On releasing the key the lever is returned to its normal position by the spring *s*. The precision of the action is greatly enhanced by the auxiliary spring *z*, which closes the exhaust valves *e e* at the very first depression of the key, thus preventing the high pressure wind from running through when the lever is at half action.

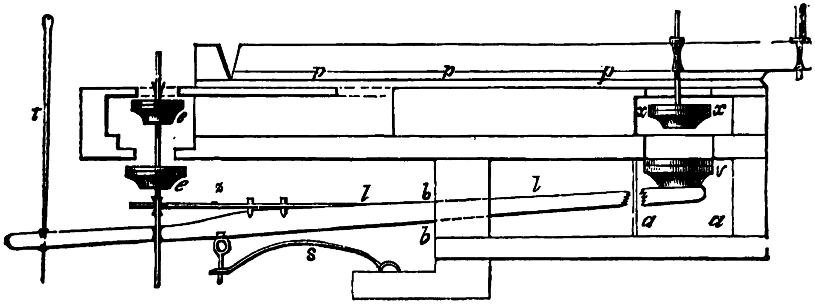

FIG. 33. THE PNEUMATIC ACTION.

Such is the arrangement applied to each note of a manual, these little systems being arranged in frames arranged one above the other the same width as the manuals, and placed as near them as possible.

Having detailed the principle and one form of the original pneumatic lever, we must, in justice to modern builders, point out that frequent improvements and modifications have been and are continually being adopted. For instance, almost all pneumatic actions are now constructed on the exhaust system, *i.e.*, in place of high pressure power-bellows containing compressed air, the wind is exhausted from these small bellows, so that the same result is produced on the mechanism by exactly the reverse *modus operandi.* This method has been adopted as it was found that the continual strain on the ribs of the power-bellows was more than could with convenience be overcome; whereas the exhausting of these caused no such strain. The manner in which this exhaust is produced is by reversing the position of the valves of the feeders, viz., placing those that are usually above the bottom-board below it, and by *hanging* the weights under the feeder instead of placing them on the top-board.

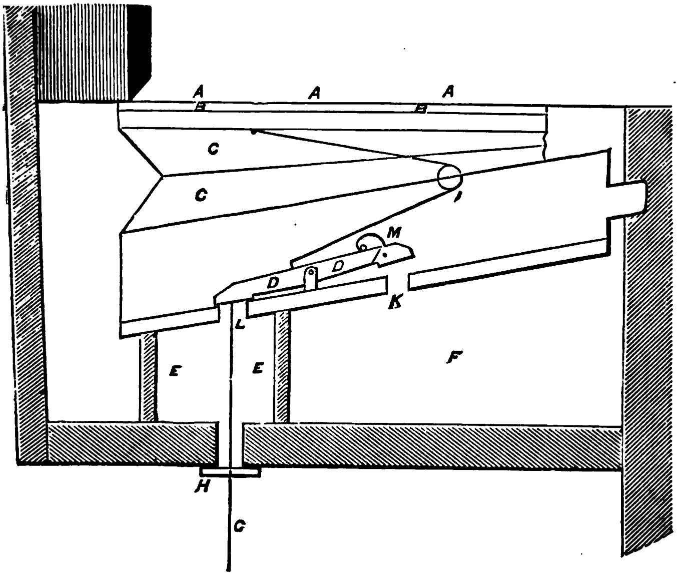

FIG. 34. BRYCESON'S PNEUMATIC PALLET.

Perhaps one of the best modifications of the pneumatic lever is that introduced by Messrs. Bryceson Brothers, who, under the title of the "*Pneumatic Pallet,*" have patented an ingenious method of obviating much of the complication found in the old form of this action.

Fig. 34 shows a section of this arrangement: A A A is the soundboard bar, immediately under which is the face of the pallet (B) as usual in ordinary action; C C are the ribs of the pallet; D D represents a double action lever valve, which, be it understood, is inclosed in the pallet itself, and is unseen under ordinary circumstances; E E is a chamber of attenuated air; F is the well of the sound-board containing compressed air; G is a metal rod passing through the metal brass plate H to lift the end of the lever valve, either by the armature of an electro-magnet, or by the ordinary mechanical action; I is the usual sound-board spring, which keeps the face of the pallet close against the sound-board bar, at the same time keeping the exhaust end of the lever valve closed; K is the aperture through which the compressed air enters the pallet when the lever valve is opened; L is an opening affording exit for the compressed air to pass out when the lever valve is open at that end, as also for the passage of the rod G, which acts on the lever valve from the action without the pallet; the small spring M is of great importance, inasmuch as it presses on a portion of the lever valve divided from the rest by a hinge so as to prevent the aperture at K opening until the hole L is almost closed.

The action of this arrangement is most easily understood. When the pallet is at rest the valve is in the position shown in the diagram. On pressing the key, the position of the lever valve is reversed by the rod G. That is, the aperture K is stopped, and the opening at L being free, an amount of exhaust is created in the actual pallet itself sufficient to at once open the passage to the pipes. On releasing the key the hole L is closed, and that at K being opened, the compressed air forces the face of the pallet up against the sound-board bar. Thus the amount of resistance offered by the pneumatic pallet is obviously extremely small. The spring I is only sufficiently on the L side of the lever valve to keep the hole well closed. All seriously inconvenient pressure must, if it exist at all, arise from causes external to the pallet, and must be treated accordingly by electric or other agency. The great importance of the spring M will be appreciated when it is observed that were it not for that, during the change of position at the lever valve, the compressed air in the chamber F would tend to neutralise the exhaust in the chamber E by rushing in before the valve was well closed. It may be almost said that the weight of the top-board of the pallet is enough to open on the pressure being cut off, and it is found in practice that very slight exhaust is sufficient to accomplish this.

The pneumatic pallet has been found to answer not only in combination with the electric action, but also as a perfect substitute for the more complicated "*pneumatic lever.*" The large organ at the Pro-Cathedral, Kensington, is fitted with these on the "swell" and "great" respectively, and we can, from personal experience, assert that a more easy, crisp, or pleasant touch we do not know. The pipes answer with a marvellous accuracy and rapidity, and the mechanism has gone through a lengthened and somewhat hard trial without requiring repair or even attention. This speaks volumes for the invention, as it is a practical trial of the most severe description, the music at this church being often of an unusually elaborate character.

It will not be necessary to again refer to the pneumatic systems until we come to the draw stop action, where this power is made of frequent and important use.

In the succeeding chapters we shall treat of the electric action in its entirety, and somewhat fully, for the importance of this branch of the builder's work is becoming every day more and more felt by all who watch or study the arts in connection with music.

* * *

CHAPTER VIII.

The Electric Action.

THE name Barker was mentioned more than once in connection with the introduction of the pneumatic lever, and although great praise is due to Mr. Barker for his labours in relation therewith, it is not his ingenuity in that field that gained for him his greatest honours. We mentioned the active part this gentleman took in the Paris Exhibition of 1855, and must go on to state that, after the retirement of M. Ducroquet, he remained with his successor, M. Merklin, until 1860, when he started on his own account with M. Verschneider as his partner, the latter being an excellent voicer, and having won his spurs by the perfect manner in which he arranged the harmonisation of the grand organ at St. Eustache, then considered one of the best in Paris.

After what has been said of the pneumatic lever apparatus, and the modifications thereof, it might be supposed that nothing more was to be gained by further invention; but it would seem that in no application of machinery has perfection in a strict sense been obtained, and it is obvious that the jump from the pneumatic to the electric action is far greater than that from the old mechanical arrangements to the pneumatic system. One great defect of the organ, especially noticeable in instruments of a large size, with several key-boards, is the number and excessive complication of its mechanical parts, all of which, however accurately adjusted, are, from their nature, particularly subject to the effects of atmospheric changes, thus, under the influence of damp, the long trackers shorten, the various levers swell, and move with difficulty on their bearings; the solid framing which supports the sound-boards by its variation, adds to the general disorder, and "*cypherings*" are the unfortunate result. Every organist is aware that in summer the touch of his instrument is reduced to a minimum, and is often totally inadequate to open the pallets enough to supply sufficient wind to the pipes, by which means the organ is rendered out of tune, and, consequently, painful to the ear. To remedy as far as possible these serious defects, the mechanical actions are provided with regulating screws (*vide*

Chap. 5). But how many difficulties have to be encountered in this delicate and tedious operation? rendered still more complex by the introduction of the pneumatic lever and the couplers. It requires great care and some amount of technical knowledge to regulate an instrument, and it has often led to serious damage when an inexperienced hand has attempted it. A great deal of all this may be obviated by keeping the interior of the organ at an uniform temperature.

It occurred to Mr. Barker, as it had already done to others, that seeing what had been accomplished in telegraphy, by which the most delicate movements are transmitted to indefinite distances with rapidity and precision, it might be possible to apply the same principle to the organ. This he actually accomplished, in the presence of repeated and uniform failure on the part of his predecessors, who quite overlooked the most essential condition of the electric transmission, viz., either to diminish the resistance of the sound board pallets to a minimum by means of an entirely novel mode of construction, or to attack them by the intervention of the pneumatic lever, reduced to simple inflated bellows, commanded by the smallest possible disc valves, and disembarrassed of all the usual accessories in the shape of couplers, which latter should be effected by the electric arrangement. A particular form of the pneumatic lever meeting all these requirements has been patented by Mr. Barker both in France and England.

Dr. Gauntlett, who had done much towards the introduction of the German or C C compass of organs in this country, now universally adopted, may claim to be the first who conceived the idea of applying the power of electricity to organ mechanism. The following notice occurred in the *Orchestra*, of March 28, 1868: "The using of electricity as a motive power in organ building was first mooted about twenty years ago by Dr. Gauntlett, who at the time of the Great Exhibition of 1851 proposed a scheme for playing all the organs in the place at one and the same time. The plan met with great opposition, and nothing was done; but on the announcement of the Crystal Palace Company, Dr. Gauntlett met the provisional committee, and proposed the erection of *facsimiles* of the eight most celebrated organs in Europe, and playing them altogether or separately in the centre of the building. The original prospectus of the company put forth the exhibition as one of still life, and one which might be grasped in one view. All such exhibitions fail unless accompanied with music, and Dr. Gauntlett's proposition was to supply the place with a continual stream of music at an outlay much less than that for the maintenance of an orchestra. Messrs. Anderson and Fuller, two gentlemen of the committee, met the proposition with a decided negative. 'Dr. Gauntlett,' said Mr. Fuller, 'you will never hear a note of music in the Crystal Palace; the exhibition is intended for far higher purposes. We do not want music, and we shall never have it;' and thereupon Dr. Gauntlett departed, but not without telling the committee that without music the whole affair would become bankrupt. Dr. Gauntlett patented his speciality in 1852, and in 1863 another plan was patented by Mr. Goundry. It is far from impossible to put a key-action under the dome of St. Paul's Cathedral, by which all the organs in London and its suburbs could be played at once; and if the clergy could be brought to celebrate the service in one time, so that all the singing could be made to go together, and one set of tunes could be found to satisfy all tastes, then the one organist in St. Paul's Cathedral would be fully sufficient for the psalmodic power of all London."

Dr. Gauntlett's patent of 1852 comprehends playing not only finger organs, but also barrel organs and seraphines, as well as pianofortes by the electric agency. For organs, he proposed placing a powerful electro-magnet immediately beneath each pallet, and fastening the armature on the end of the pallet itself, an arrangement which would require great space for its application and an amount of electric force that could only be obtained by very large and powerful batteries. He certainly mentions that the "pneumatic lever" may be worked with the electro magnets and armatures; but omits to give details of any manner in which this could be accomplished. Dr. Gauntlett's contact at the key had the disadvantage of not acting till the key was quite down, and being simply a touch contact would require the application of platinum to prevent oxidation, and even then would not be absolutely certain in its action.

In the year 1868 Mr. Goundry, also an amateur, patented a very intricate electric system, chiefly in connection with the introduction of the enharmonic scale, which requires forty sounds to the octave. He describes several forms of light pallets already known to the trade, and proposed to open them by a direct application of the electro magnet, as did Dr. Gauntlett. The pneumatic lever was not only mentioned, but a definite form introduced for its application. Mr. Goundry had an extremely elaborate arrangement for coupling purposes as well as for making the melody prominent. He proposed that a spring should pull the slider in in the drawstop action and that it should be drawn out by a pneumatic power bellows, acted on by an electro magnet, around which the electric current would be passing all the time the slider was drawn, which arrangement would involve an enormous amount of battery power in the case of continued playing, especially on large instruments.

It is not surprising that these inventions were not taken up by builders, when the difficulties that were yet to be surmounted to produce a useful instrument are considered.

During the Paris Exhibition of 1867 the attention of Messrs. Bryceson Brothers was directed to the St. Augustin organ, built by Mr. Barker, then almost complete, and they at once saw the immense advantages to be gained in large instruments by the electric system when properly carried out, and they immediately arranged for the sole concession for this country; subsequently, at Mr. Barker's urgent request, they gave up the *sole* concession, as he afterwards thought that if in the hands of one firm only, the general adoption for all large work would be delayed, and consequently yield him less profit during his lifetime than if he were to grant concessions to whoever might require them from time to time.

The patent that Mr. Barker took out in 1868, and which was the one that Messrs. Bryceson worked, protects his special arrangements of the following applications, all of which, with the exception of the drawstop action, were based on his own practical experience, gained in the construction of the three electric organs he had erected on the Continent.

1st. His arrangement of the electro-pneumatic action to the keys and pedals, including a method of making the contacts by immersing copper points in mercury cells.

2nd. A contrivance for coupling the various rows of keys as well as the pedals, either in unison or in octaves.

3rd. An arrangement for drawing the stops.

4th. The manner of commanding the large valves in wind trunks or ventils.

5th. An automatic system for preventing all waste of electrical agents when not actually in use.

Fig. 35 is a reduced copy of the drawing attached to Mr. Barker's English patent, dated 28th Jan., 1868. It represents the end section of a divided sound-board, such as would be used when two different pressures of wind are required where the number of stops is so great as to necessitate two pallets to supply a sufficiency of wind. The chamber, C, in the wind-bar is supplied with compressed air, and is continued the whole length of the soundboard; this is to supply the pneumatic power bellows, P P, which are all fixed externally on the bottom side of the sound-board, one of these power bellows being provided for each pallet. Immediately below the air chamber, C, and upon the fixed table of the power bellows, is a small double action disc valve, D D, attached to a vertical rod, R. In a state of rest, as shown in the drawing, the top disc valve is closed, cutting off the compressed air, and the lower one is open, so as to establish a communication from the interior of the power bellows with the atmosphere, and allowing the sound-board spring to hold the power bellows shut. The disc valve, D D, is actuated by the armature, A A, of an electro magnet, M M, placed below, and attached to the vertical rod, R; so that when the electro-magnet is excited by a

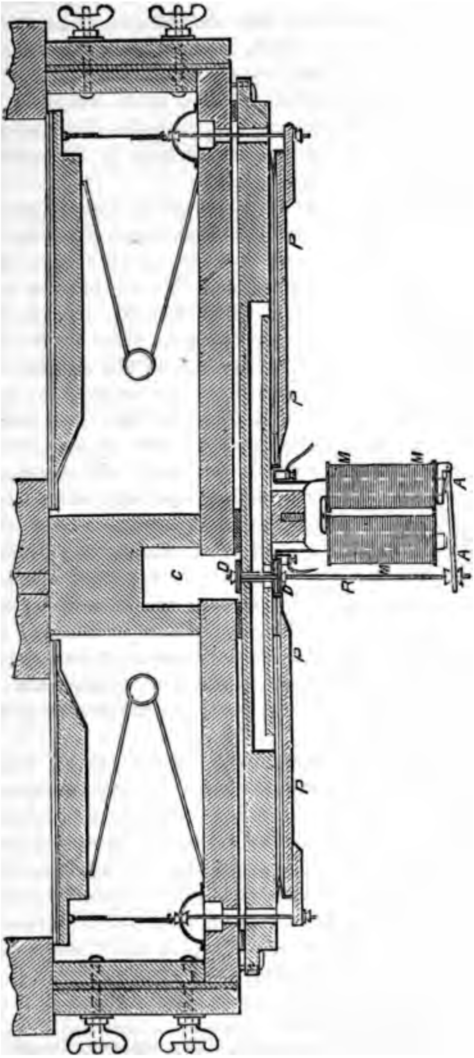

FIG. 35. APPLICATION OF THE ELECTRIC ACTION.

current, and by this means is made to attract the armature, the position of the disc valve, D D, is reversed: the lower one being shut and the top one opened, the compressed air from the chamber above rushes in and inflates the power bellows, which, being attached to the soundboard pallets, immediately pulls them open. Directly the current ceases the armature is, of course, released, the disc valve returns to its former position, the compressed air is cut off, the sound-board spring collapses the pneumatic power bellows, and the air escapes by the bottom disc, or exhaust valve, which is now open again.

A sound-board, therefore, with its electro pneumatic power bellows, applied to both pallets and sliders, requires no train of moving mechanism to connect it to the keyboard and draw stop knobs, however distant, but simply the necessary number of insulated copper wires to conduct the electric currents from the console, which holds the manuals, pedals, &c. The console thus detached from the main body of the instrument contains a vast amount of accurate and beautifully arranged work. Its dimensions may be compared to those of a large harmonium; and, besides holding the various keyboards, it contains—first, the rocking lever beneath each key, which, being furnished with copper points, plunges them in mercury cells directly it is depressed, and so establishes the electric current; secondly, the various couplers, which are bars of wood, on which are screwed copper springs for each note, when drawn by the knob these metallic springs press against corresponding copper plates, and so cause the electric current to divide and actuate the additional electro magnets and pallets at the same time; thirdly, the draw-stop knobs and traces, to which contacts of a similar nature are attached, and which likewise complete the circuit of the electric currents to their respective positive and negative electro-magnets; fourthly, all combinations which act mechanically on the draw-stop traces and other accessory movements.

Inasmuch as that these electric arrangements are all patented, and in the hands for the most part of Messrs. Bryceson, it is enough that we give sufficient description that the principle be thoroughly understood, for should further detail be required it is easy to refer to the patents themselves, or the larger text-books. In fact, it is only possible that we can give what has been previously published on this subject. But the matter is of such great importance that it becomes essential that all who study the construction of organs should have a clear idea as to how the electric agency is employed.*

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* The greater portion of the facts as stated above were read before the Society of Arts, Wednesday, Dec. 23, 1868, by Mr. Henry Bryceson (Bryceson Bros. and Ellis, London).

It has been found in relation to galvanic batteries that the wear and tear takes place during that period in which the circuit of the cell is completed; and in theory, if the plates are properly amalgamated, they are not effected by mere immersion in the exciting fluid, but in practice it is always better to remove them when the battery is no longer required; more especially is this found of advantage with those batteries in which a solution of the bichromate of potash is used. In any case when the amalgamation on the surface of a zinc plate becomes imperfect, the two metals (mercury and zinc) are inclined to form "surface circuits" on the plate itself, and by this setting up of minute currents between various points, not only gradually decompose the plate, but, what is of far more importance, seriously weaken the individual action of the cell. It is a law worth remembering, that, when in use, *the power of a battery made up of a given number of cells is equal to the sum of such a number of the weakest cell in the circuit.*

To effect the removal of the plates, which, if left to the memory of an attendant, might often be forgotten, Mr. Barker placed the jars containing the liquid on the top of a wind reservoir supplied from the main bellows, and suspended the plates in a frame above. When the bellows are blown the reservoir becomes inflated, raising the cells so as to immerse the plates; when the wind ceases the reservoir gradually collapses and the jars sink down, leaving the suspended plates high and dry. The battery is not placed within the console, or of necessity in any particular portion of the instrument, but wherever it is convenient—generally in or near the organ itself.

It may be well to mention that the usual form of battery employed is simple, inexpensive, and easily replenished from time to time with the necessary ingredients by any careful person. It does not require attention more than four or five times a year at the most. Those who are ignorant on the subject are apt to imagine that electricity is a treacherous or uncertain agent, but it is obvious that chemicals of equal quality, under given and similar conditions, must render like results in their actions. Notice of any falling off in the battery power is given by means of a galvanometer placed in the console for this purpose. At the same time it shows whether or not the wind is in the organ, as indicated by the immersion of the plates. Thunderstorms or other atmospheric conditions in no way affect the action of an electric organ, as earth currents are never utilised as in telegraphy.

It will be noticed that in the electric key action two intermediate agents are employed, to make the depression of the key open the pallet in the sound-board, viz., electricity and pneumatics, and it might be with reason supposed that such a complication would tend to produce a slowness or delay in operation. This has not been found the case in practice. The electric current takes no time that the senses can appreciate in going even miles, and in the short circuit employed in organs electricity performs its work simultaneously with contact being made at the key. The pneumatic power-bellows, unlike those used in a mechanical organ, where they must be of sufficient size to pull open several pallets at once, to say nothing of having to move long trains of action, are now only required of a power to open one pallet, and are therefore reduced to such a size that very little compressed air is enough to inflate them; moreover their small and sensitive valves are in no way impeded by mechanical attachments. The practical result of this is that no perceptible difference of time can be discovered between the depression of the key and the speech of the pipe. This is proved beyond all doubt by the excellent repetition touch which is invariably obtained when the electric action is properly constructed, for in this respect it not only equals but far surpasses any mechanical action whatever.

In most cases where organs already built are to be reconstructed on the electric system, it has been found advisable to apply externally a pneumatic power-bellows beneath each original pallet, similar to Mr. Barker's arrangement, but placed in tiers, so as to get them in the same length as the sound-board. These are worked by the exhaust system, attenuated air being used instead of pressure, for the following reasons: The ribs or sides of pneumatic power bellows, if not made very rigid and lined with cardboard, are subject to being overstrained and inverted when they are inflated, and thus either permanently locked, open, or destroyed. If they are made of a rigidity that secures them from this defect, they are not sufficiently free in their action in the treble or smaller size. By the use of exhaust in lieu of pressure, no stiffening of the ribs is necessary, the cost of manufacture is reduced, and at the same time greater durability and freedom from noise is attained. In the conversion of organs to the electric system, all the existing mechanical action, being useless, is set aside, and consequently under these circumstances the expense is greater in proportion than where a new instrument is provided. The cost of this action must necessarily exceed that of ordinary construction, unless similar conditions are imposed, in which case comparison will be doubly favourable, when the addition of the more valuable and imperishable materials employed is taken into consideration.

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CHAPTER IX.

The Draw-stop Action—Commutation Pedals.

THE term "draw-stop action" is given to that mechanism which regulates the movement of the sliders, and thus commands the various stops or ranks of pipes on the sound-board. It, therefore, is necessarily situated between the claviers and the ends of the sound-boards. It may be either purely mechanical, pneumatic, electric, or composite in its construction. Properly speaking, the *composition pedals* come under this head, as they also command the sliders collectively.

In all modern organs the knobs which control the stops are placed within easy reach of the performer, and in the larger instruments they are usually situated on either side, arranged in sets relating to the various departments on which they act, the couplers, or those connected with mechanical combination movements, being on the left.

The earlier organs had no draw-stop action. This addition to the instrument was made in the sixteenth century, and it is only within the last hundred years that there has been any recognised method of bringing all the knobs of the various departments together, and within easy reach of the player.

The exigencies of position, space, &c., tend to make the mechanical form of this action assume various individualities in different organs, but there are important principles which characterise more or less every specimen. The usual forms come under one of two great divisions—viz., the wooden trundle action or the iron trundle action. In the making and arranging of these the relative positions of the claviers and the sliders must be taken into account. The one most frequently assumed is that in which the great organ sound-board is immediately behind the front show pipes. It is quite immaterial at which side of the sliders the action is attached, and in small organs of one manual it is generally arranged that half are on one side and half on the other.

Presuming the position above described to be taken, Fig. 36 gives an illustration of the wooden-trundle arrangement. Starting from the end nearer the claviers, K is the draw-stop knob, appearing at the consol, on the ivory face of which is engraved the name given to the particular set of pipes it commands. R is the drawstop rod, to which the knob is attached. This rod may be of great length or only a foot or so, according to the distance of the trundle from the manuals. Draw-stop rods are usually about an inch thick, whether round or square, which is a matter of taste. The end of the rod is mortised to receive the arm A, which is kept in position by a small iron pin. This arm is fixed at right angles to one side of the trundle T. The trundles are square, and are made of stout wood, thoroughly seasoned, for were these to warp, the sliders would be inaccurately drawn or closed.

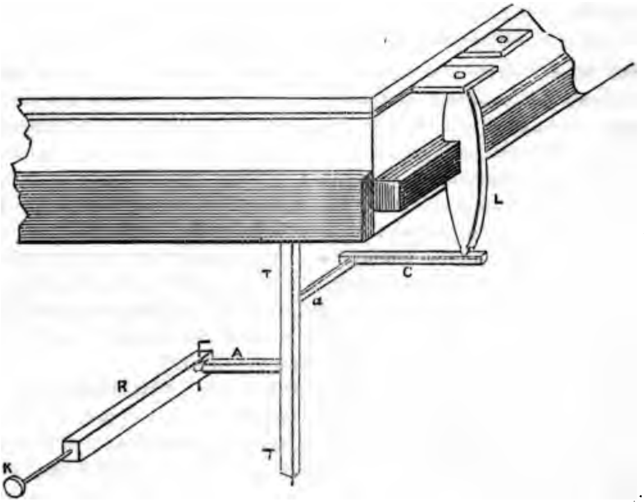

FIG. 36. THE WOODEN TRUNDLE ACTION.

Each trundle rotates on iron spindles fixed to it at either end, which move in framework suitably placed to receive them. Another arm, *a*, communicates with the trace C, by means of a mortise and pin. The trace is made of pine, and reaches from the second arm to the lower end of the lever L, to which it also is mortised. The lever is of beech, oak, or some other hard wood, and is hung on a centre about a third from its upper extremity. The upper end of the lever is fitted into a hole in the slider; the trundle arms A, *a*, have no actually fixed positions, though the first is always placed as nearly on a line with the rod as possible, and the second in a like position to the lever; these arms are occasionally made of iron.

The action of this arrangement is easily understood. When it is desired to bring a given stop into play, the knob K is drawn forward, which, of course, brings with it the rod R. The rod pulls the trundle arm A in the same direction, and the trundle T revolves on its axis a quarter of a turn, causing the arm *a* to draw the trace C from right to left. This acts on the lever L, the lower end of which goes inwards, whilst the upper end in its outward course takes the slider with it. The reverse of this would silence a stop already in use.

In the iron trundle draw-stop action, the trundle and arms are made of wrought iron instead of wood (Fig. 37 shows this arrangement). The trundle T is placed at the edge of the sound-board and not under it, as in the wooden-trundle action. The upper end U is above the level of the bottom of the sound-board. The trace is entirely dispensed with by making the bottom arm A much longer, so as to reach from the draw-stop rod R to the trundle. The top arm *a* is at the upper extremity of the trundle, in fact, may be termed a continuation thereof, and is made to incline towards the slider S, to which it is fixed by a bolt. On pulling forward the knob K the trundle is turned as in the first case, and acting immediately on the upper arm the slider is drawn out.

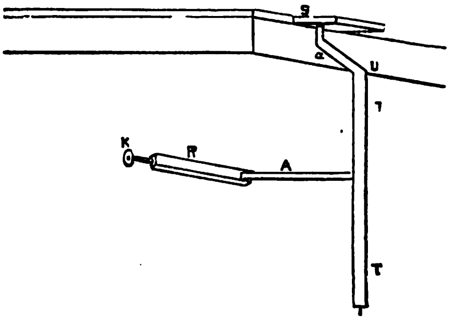

FIG. 37. THE IRON TRUNDLE ACTION.

There is another action for commanding the stops, patented by Messrs. Herbert and Beale, called the "commutation pedal" movement, which has been applied to small one manual chamber organs with great advantage. The stops are in this arrangement acted on by pedals, which on being pressed alter their position, whatever that may be. Thus, suppose in an open diapason the slide is in and the stop silent, pressure on the pedal at once brings the slide out and renders the stop available;

but should it be already out, pressing the pedal closes the slider and shuts off the pipes.

Fig. 38 shows the mechanism: S is the end of the sound-board, *c* is a slide, and J a fixed guide. The pedal is connected at *i* by any suitable arrangement of rods, levers, &c., according to circumstances. The depression of the pedal causes the rod F to rise, and its upper end, engaging in one of the hollows of the cam A, rocks the latter on its centre B, and moves the slide *c*; on the release of the pedal, the rod F, which if necessary is weighted, drops out of *f*, and the roller G descending the incline presented by the wire E, the pedal returns to its normal condition. The next depression of the pedal will cause the rod F to engage in the other hollow of the cam, restoring the slide to its original position. In this arrangement each commutation pedal may be connected to a single slide or to several, as is convenient. If it be desired, the mechanism may be arranged to act on two sliders, so as to reverse them under any circumstances, or it may be arranged so that, if one slide has been moved by hand without the other, the depression of the pedal will move the other in the same direction; a subsequent movement reversing both simultaneously. The ordinary draw-stop action may be retained and connected to the slider as usual, or to the cam, as seen at *m* or *n* in Fig. 38.

In using these pedals for the speaking stops of small one-manual organs, the advantage gained is, that by reason of the very slight pressure required to alter the slide, the stops can be quickly regulated without the removal of the hands from the keys. It is needless to point out how useful such an arrangement may be for the command of couplers or heavy pedal reeds on large instruments, where the hands can seldom be spared.

The application of the pneumatic power-bellows to the sliders was naturally suggested on its successful interference on behalf of the key action; and a moment's consideration will show that it is more than ever of use in moving the tight sliders, and dispensing with the heavy action that would make the drawing of every stop a matter of considerable exertion. The power-bellows are actuated either by a train of mechanical action, by electro-magnets, or by means of a contrivance which may be termed the "tubular transmission." The first arrangement is purely pneumatic, the second is compound electric and pneumatic, and the third is pneumatic in its principle.

In the tubular arrangement the stop-knob at the keys moves a peculiar kind of double action valve, which places a tube, in connection with the pneumatic power-bellows at the end of the slider, under the influence of either exhaust or pressure, according to whether it is drawn out or pushed in, thus obtaining the alteration in the position of the slider. The transmission through the tube, which is merely a leaden gas pipe, can be effected to any distance, and in this arrangement all the complications attending mechanical movements are dispensed with, and an enormous saving of space is the result.

The simple pneumatic draw-stop action is accomplished by fixing a power-bellows of sufficient size on a vertical board, as shown in Fig. 39. The slide to be acted on is connected by a lever, or other mechanical arrangement, to the moving part of the power-bellows. In the figure it will be seen that three chambers, A, B, C, are fixed on the reverse side of the vertical table, T. These chambers communicate with each other by two holes in the partitions between them, but this communication is determined by the position of a double action valve, consisting of a rod, *r*, and two discs, *d d*, with suitable seats on the partitions. The upper chamber is supplied with a pressure of air from bellows connected with it by a trunk not shown in the drawing. The other chamber,

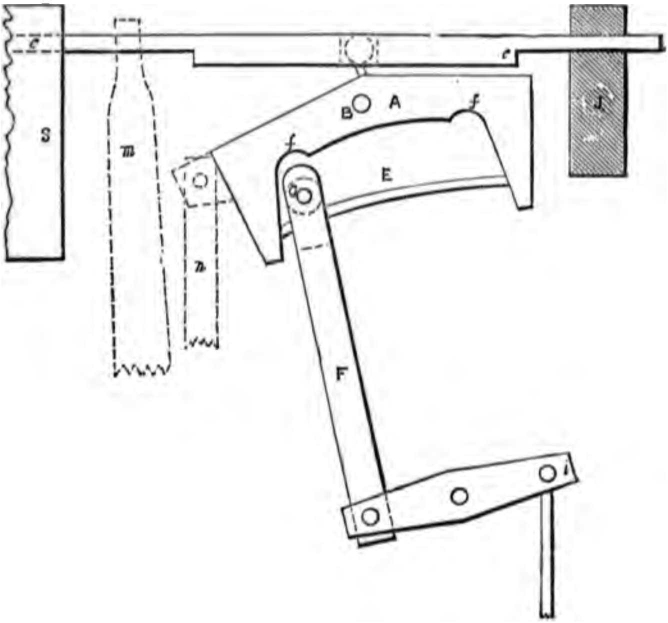

FIG. 38. THE COMMUTATION PEDAL.

C, has the air exhausted from it by any convenient means; the middle chamber, B, communicates with the interior of the power-bellows, P. When the double-action valve rod, *r*, is pulled down it removes one disc, *d*, from its seat on the partition of the supply chamber, A, and closes the hole in the exhaust chamber, C, thereby allowing the compressed air to pass through the chamber, C, into the power-bellows, P, and thus through the rod, R, to move the soundboard slide one way. On reversing the valve the wind from the supply chamber, A, is cut off, and communication with the exhaust chamber, C, is established, thereby causing the power-bellows, P, to collapse, as shown in Fig. 39, and move the rod, R, and the soundboard slide in the reverse direction. This double-action valve can be commanded at the console either by a mechanical arrangement of levers, connecting-rods, &c., by the application of electricity and electro-magnets, as also by the tubular action mentioned above. If electricity is employed, it is necessary for the sake of economy to introduce intermediate or accessory power-bellows. The

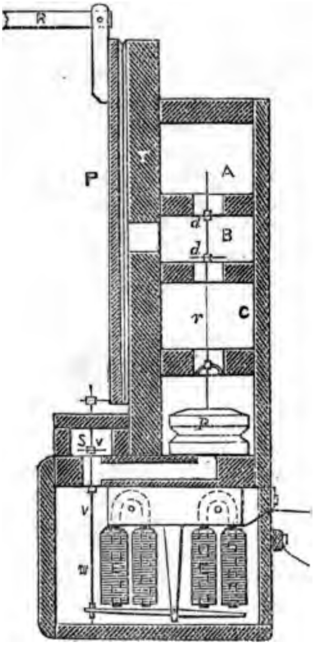

FIG. 39. THE PNEUMATIC DRAW STOP ACTION.

accessory bellows shown at *p*, in Fig. 39, is supplied by a separate disc-valve, *v*, from the supply chamber, S, in connection with the main power-bellows, and may be actuated by two electro-magnets, E E.

The means by which the two distinct positions of the double-action valve of the main power-bellows is insured is as follows: The two electro-magnets, E E, are placed in such a position that their armatures can act on the rod, *w*, carrying the disc-valve, *v*, that admits compressed air to, and discharges it from, the accessory power-bellows, *p*. These accessory bellows are connected to the rod, *r*, of the main double-action valve which actuates the main power-bellows that moves the slide through the rod, R. Thus, by moving a draw-stop knob at the keys one way a contact is made which completes an electric circuit, and produces a current of electricity which actuates one electro-magnet, E, and closes the escape valve of the accessory bellows, *p*, and at the same time opens the supply valve which allows the compressed air from the chamber, S, to inflate the accessory bellows, and pull the rod, *r*, of

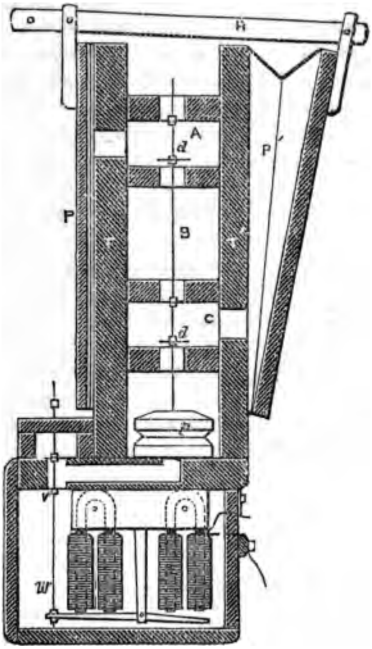

FIG. 40. THE DOUBLE BELLOWS DRAW STOP.

the main double-action valve one way. On moving the stop-knob at the keys in the reverse direction a contact is made which actuates the other magnet, E, and thereby alters the position of the disc-valve, *v*, of the accessory bellows, *p*, cuts off the supply, and allows the air to escape from the bellows into the atmosphere. The accessory bellows will then collapse and reverse the position of the main double-action valve.

Fig. 40 is a modification of the above, two pneumatic power-bellows, P P, being employed in combination. These two bellows, P P, are adapted to the two vertical boards, T T, between which are arranged the compressed air and exhaust chambers and their valves. In this instance the bellows are worked on the exhaust principle; B is the exhaust chamber from which the air is exhausted in any convenient manner; *d d* are valves for connecting the chamber, B, with the chambers, A C, which are in communication with the pneumatic bellows, P P. The valves, *d d*, are worked by means of the accessory bellows, *p*, as in the former instance, and the rod, R, of the draw-stop slide is shown in the figure as having been drawn over to the right. Now, if the electro-magnet, E, is put in action, it will attract its armature, and draw down the valve rod, *w*, cut off the supply of compressed air to the bellows, *p*, and at the same time open the communication through the lower valve, *v*, with the atmosphere. The bellows, *p*, will then collapse, draw down the rod and close the top valves, *d d*, at the same time opening the bottom ones. The air from the bellows, P, will then rush into the exhaust chamber, B, the bellows will collapse, and thereby push the slider-rod, R, in the opposite direction and at the same time open the other bellows, P, which will be inflated from the chamber, C, which is in communication with the atmosphere.

* * *

CHAPTER X.

The Pneumatic and Electric Draw-stop Actions.

Where a double action draw-stop movement with one electro-magnet and one pneumatic bellows is to be used in conjunction with an electric signal, a pneumatic power-bellows is established on a fixed table, as shown in Fig. 41. On the under side of this table, T, are three chambers, A, B, C. These chambers communicate with each other and also with the atmosphere by four holes in the partitions between them. This connection is regulated by the position of double-action valves, *v v*, composed of rods and discs, as before described. The end chamber, B, communicates through the table, T, and with the interior of the power-bellows, P. The chamber, A, contains compressed air, which is supplied by bellows or otherwise. The double-action valve rod is operated by an accessory bellows, *a*, which, when required, is inflated by air from the chamber, A, which passes therefrom through a valve, *v*, into the chamber, C, and thence to the bellows, *a*. The valve, *v*, is controlled by the electro-magnet, E, caused to act on its armature by depressing the stop button situated near the manuals, and marked *f*, on the left of Fig. 41, and to the stem of the button are attached two light springs, *f′*, which bear against blocks, *g*, formed of vulcanite or some other non-conducting substance. Strips of metal, *g′*, are secured to the blocks, *g*, and are connected by the screws, *h*, with the electric wires which lead to the magnets, E, in the other division of the figure, and also to the battery, as shown in the drawing. The lower end of the shank or spindle of the button, *f*, is provided with a spring which will return the button to its original position, when the pressure of the performer's hand is removed therefrom. It will be obvious that every time the button, *f*, is depressed it will complete the electric circuit and will actuate the magnet, E, which, by attracting its armature, will lift the valve rod, *v*, and open its valve so as to allow wind from the pressure chamber, A, to pass through the chamber, C, into the accessory bellows, *a*, and inflate them, and by so doing draw back the valve rod, *v*, and open the communication between the chambers A and B, so as to allow the wind to pass

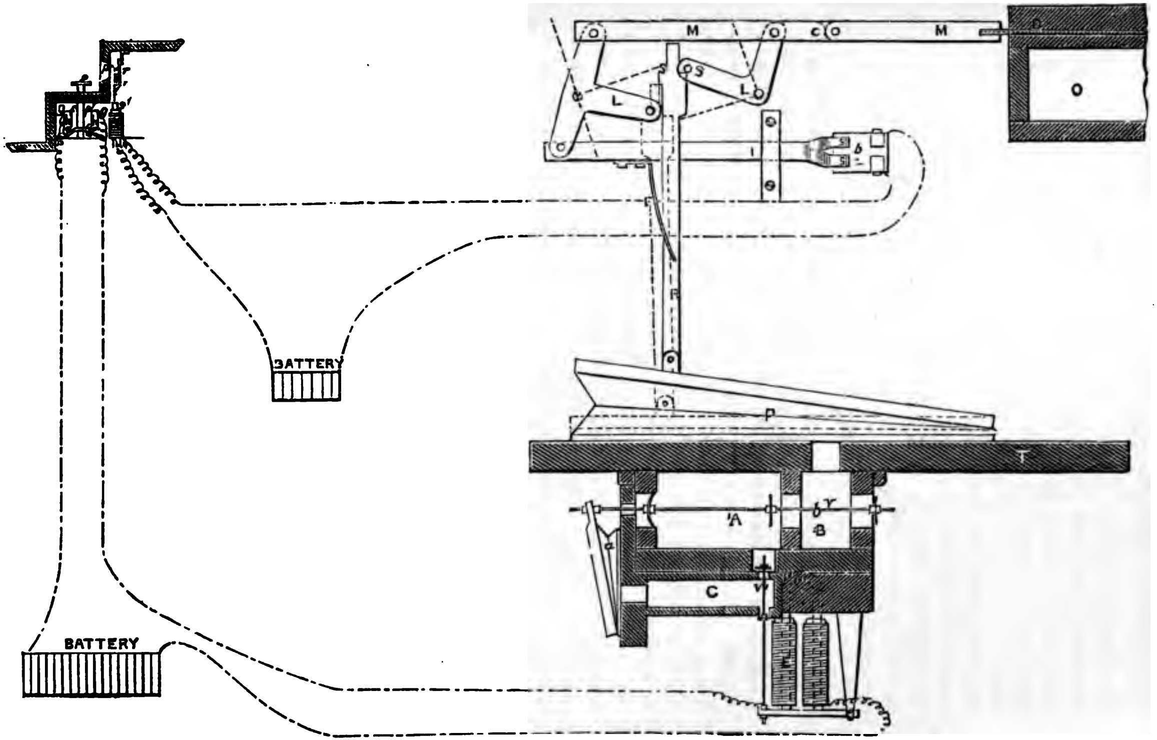

FIG. 41. DOUBLE-ACTION ELECTRO-PNEUMATIC DRAW-STOP.

into and inflate the pneumatic power-bellows, P. This action will raise a rocking rod, R, which is provided at its upper end with two shoulders, S S. Two bell crank levers, L L, are connected by a link motion, M, to the draw-stop slide, D, of the soundboard, O. The upper arms of the lever, L L, are jointed to the link, M, and therefore both of them move simultaneously. The lower arm of the lever, L, is jointed to a slide, I, which is provided with a flat spring, F, the lower end of which bears against pins fixed in the rocking rod, R; the horizontal arms of the levers, L L, are provided with projecting pins, against which the shoulders, S S, of the rocking rod, R, are caused to act alternately. When the bellows, P, is inflated as shown in the drawing, one of the shoulders, S, of the rod, R, will come against the pin of one of the levers, L L, and by lifting this lever will push forward the link, M, and at the same time will draw back the slide, I, and thus put tension on the spring, F. Upon the performer taking his finger off the button, F, and allowing it to rise, the electric circuit will be broken, and the position of the valves, *v* and *v*, will consequently be reversed; the bellows, P and *a*, will then collapse and be ready for a second operation. Upon the button, *f*, being again depressed, the same operations will be repeated, but the rod, R, will, by the tension of the spring, F, be thrown over in the opposite direction, as indicated by dots, and will bring the other shoulder, S, under the spring of the other lever, L, so that when the rod, R, rises by the inflation of the bellows, P, the link, M, and draw-stop slide, D, will be drawn in the opposite direction to that before described, as a depression of the button or knob, *f*, at the manual, either brings the draw-stop slide on or takes it off. As in both cases the button returns to the same position, it is necessary for the convenience of the player that an index should show the actual position to which the slide has been moved and has been left. This index is arranged as follows: Immediately behind the button or knob (*f*, Fig. 41), or in any other convenient position near it, a hole, *p*, is made in the

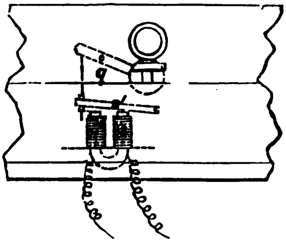

FIG. 42. INDICATOR.

draw-stop jamb or front board; behind this hole works a lever, *q* (shown by dots in left portion of Fig. 41), and carrying at one end a coloured disc or label (*q*, Fig. 42). This lever, *q*, is so balanced on its centre of motion that when at rest a fixed disc (*r*, Fig. 41), indicating that the slide is closed, appears behind the hole, *p*, the opposite end of the lever, *q*, is attached by a rod or a wire, as seen in Fig. 42, to the armature, *s'*, of an electro-magnet, S S, which is in connection with a battery and the slide (I, Fig. 41). At the end of the slide, I, there is a fixed block, *b*, made of some non-conducting material and provided with two metal plates to form terminals. On the end of the slide, I, is fixed a forked spring, *s*, so that when the slide is moved back by giving motion to and drawing out the draw-stop slide, D, as already explained, the spring, *s*, will be brought into contact with the terminals on the block, *b*, and by completing the circuit, the current will pass through the magnet (*s*, Fig. 41), which, by acting on the armature, *s'*, will draw down one end of the lever, *q*, and raise the coloured disc (Fig. 42), behind the hole, *i*, and thus indicate that the draw-stop slide (D, Fig. 41), is open. Upon depressing the button (*f*, Fig. 41), a second time, in order to close the draw-stop slide, D, the slide, I, will be drawn back into the position shown in the drawing, and the electric circuit being thereby broken, the lever, *q*, with its disc, will fall into its original position, shown in Fig. 42, thus indicating that the stop is closed.

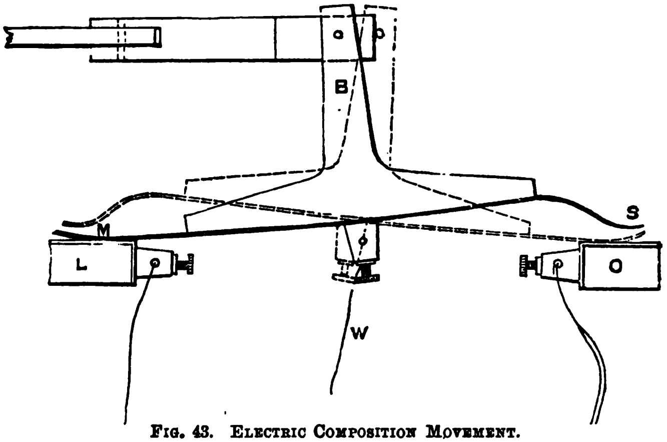

FIG. 43. ELECTRIC COMPOSITION MOVEMENT.

For a composition movement in connection with an electric draw-stop action, a bell crank lover, B, is connected to each slide by its middle arm, as shown in Fig. 43; two metal springs, M S, are fixed at the ends of the other two arms of the lever, B, and by the movement of the draw stop-slide are alternately brought into contact with the metal surface of the blocks, L O; these metal springs, M S, are by means of the conducting wire, W, in connection with one of the poles of the electro-magnet which works the slide of that particular draw-stop. On depression of the knob or pedal placed in a convenient position at the console, an electric communication is established from one pole of the battery to the terminals of each of the bell crank levers, B. The current can only pass through those levers which are in a suitable position. For instance, Fig. 43 represents the stop open, that is, with the spring piece, M, on the lever, B, in metallic contact with the block, L, thereby completing the circuit so as to allow that slide to be withdrawn. Should any of the stops of the composition be already withdrawn or closed, the lever, B, would be in the position indicated by the dots, and therefore the circuit would be broken and no effect would be produced; but if it be required to open the stops the other knob must be depressed, and the electric current will then pass to the blocks, *o*, and thence through such of the springs, S, as may be in contact therewith (as indicated by the dotted lines), to the lever, B, and thence to the magnet. If, however, any of the stops should happen to be already open, the lever, B, would be in the position shown in the drawing, and consequently the springs, S, would not be in metallic contact with the blocks, *o*, and the circuit not being complete no effect would be produced on those particular slides.

* * *

CHAPTER XI.

The One-manual Solo Organ.

THE advantages to be obtained by adding to an ordinary organ of one manual and pedals a second manual, with, say, as many registers as the first, are too obvious and well understood to need enumeration. On the other hand, such an alteration would almost double the cost of an instrument, and at the same time greatly increase the amount of room necessary for its reception.

Messrs. Herbert and Beale have patented some designs which in a great measure impart to small organs of one manual the capabilities of those possessing two, and although by no means meant to supersede or even equal the effect of the second manual, there can be no doubt that these arrangements allow solos of certain limits to be executed on the single manual. At the same time little or no extra space is required, and the cost is not increased to such a degree as the advantages gained would appear to warrant. The inventors do not imply that their organ is intended to cope with the larger instruments, but that it is "designed to obtain more especially the capability of solo playing, possessed hitherto only by the two-manual organ."

In describing the "One-Manual Solo Organ" it will be found convenient in the first place to speak of the construction of the instrument, to consider next its capabilities for solo playing, and, finally, to see in what further respect it may possess the resources usually only allowed the two-manual organ, to which comparisons will be made, not with a view of asserting the equality of the new instrument in any particular respect, but rather as a convenient means of ascertaining to what extent its resources will compare with those of an average organ of two manuals.

A convenient mode of describing the construction of the "One-Manual Solo Organ" will be to consider it as an instrument of one manual and pedals, with certain additions and modifications.

Should the ordinary portion of the instrument (hereafter, for the sake of distinction, termed the "Great Organ") contain two or three stops, there would be added to it one or, if more than two or three stops, two sets of special pipes, each set consisting of twenty-six pipes, speaking the notes indicated as within the bracket marked A (Fig. 44), but so placed on the soundboard as to be commanded by keys an octave higher, the position of these keys being indicated as in the bracket A (Fig. 45). Each set of pipes is governed by a draw-knob in the usual way. The power and character of tone of these special pipes are carefully adapted to suit the stops of the great organ.

The keys within the bracket A (Fig. 45), that command the extra pipes are so constructed that a very slight force will depress them a little, without in any way affecting the ordinary organ action. This arrangement, which is called the "free touch," does not affect the fingering. So extremely light is it, and shallow, that its addition to the real touch is sufficiently slight to be unnoticed. The use of this extra touch is to cause either the playing upon, or the mere touching without sounding, of any one or number of the keys above the upper limit of the bracket B (Fig. 44), to silence *all* the special pipes belonging to the keys within the bracket B (Fig. 45). This is accomplished by an arrangement of slides with a novel and delicate pneumatic action, operated by the free touch only, the further depression or non-depression of the key being incapable of affecting it.

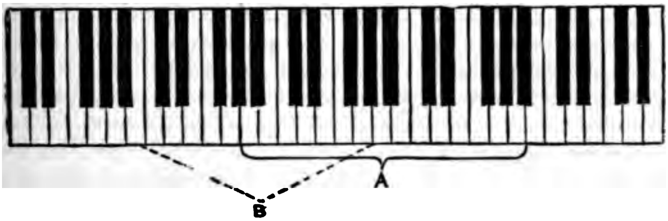

Fig. 44. Diagram of One-Manual Solo Organ.

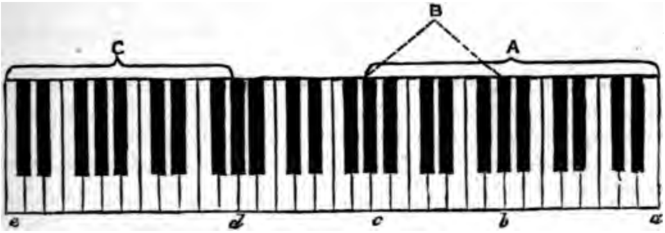

Fig 45. Diagram of One-Manual Solo Organ.

By the action of a small lever, similar in design to a swell pedal, and marked "Chords," this pneumatic mechanism is disconnected, so that the silencing of the special pipes as above described does not take place.

A draw knob is provided, which, on being pulled, closes by means of an extra slide the principal or other loud 4ft. stop, excepting those pipes of it which appertain to the keys within the bracket c (Fig. 45).

This knob, marked "Senza Principal," is independent of the ordinary Principal knob, which acts as usual.

If, as is sometimes the case in very small organs, the Open Diapason or other 8ft. stop does not run through, the bass of the Hohl-flute or Stopped Diapason is made to draw separately to meet the Open Diapason. But the actions are so arranged that if either the Open Diapason or the Hohl-flute treble is drawn, the bass is drawn with it, and if both treble slides are open the bass is, of course, also open. If either treble is closed without the other the bass remains on, but if both trebles are closed the bass also closes. Again, if it is desired to shut the three together, the bass knob only need be pushed in, which action will close the trebles also. In this way the advantages of grooving the bass are secured in an increased degree, and with a diminished cost, while the further advantage is obtained that the bass can be drawn without either treble to give strength and depth to the lower notes when playing on 4ft. stops only an octave lower than written.

Except that the special pipes may sometimes with advantage be inclosed in a separate swell box, nothing of importance remains with regard to the special peculiarity of construction in the instrument.

The two following specifications are illustrative of typical "one-manual solo organs":

I.

	1. PIERCED GAMBA. 8ft. *In tone; in scale and voice rather louder than open diapason.*
1. Open Diapason. 8ft.	2. Principal. 4ft.
2. Hohl-flute. 8ft.	3. Flute. 4ft.
3. Dulciana Prin. 4ft.	4. Piccolo. 2ft. Soft.

II.

	1. SALICIONAL. 8ft. *Voiced rather full and loud.*
	2. CORNOPEAN. 8ft.
1. Open Diapason. 8ft.	3. Principal. 4ft.
2. Dulciana. 8ft.	4. Dulcet. 4ft.
3. Rohr-flute. 8ft.	5. Flute. 4ft.
4 Dulciana Prin. 4ft.	6. Piccolo. 2ft. Soft.
5. Celestina. 4ft.	7. Flageolet. 2ft. Soft.

The registers indicated in the left-hand column are those usual to a one-manual instrument, in this case termed the "great organ." It will be obvious from what has already been said that the keys within the bracket A (Fig. 45), become an independent manual of the compass indicated as within the bracket A (Fig. 44), with the stops shown on the *right* of the specifications, those shown in capitals being obtained from the special pipes, and the rest from the ordinary or great organ stops.

Any solo part lying within the compass of this manual may therefore be played with any accompaniment ranging from the lowest note on the keyboard to the highest key within the bracket *B* (Fig. 45), except when the solo goes itself within that bracket, in which case the accompaniment must be excluded therefrom and kept below its left-hand boundary. The solo part may, of course, be given on any selection of stops from those shown on the right of the specifications, while the accompaniment will sound on the stops opposite to them on the left.

The compass thus obtained for accompaniments is, with few and slight exceptions, sufficient, because in the main the accompaniment lies higher when the solo goes high, and *vice versâ*, although they do not coincide or move necessarily together; and it is found in practice that the restrictions as to the highest notes of the accompaniment do not lead to any more serious result than the occasional omission or lowering an octave of a note, except in passages where the solo remains low and the accompaniment high. In such instances, by registering only a 4ft. stop for the accompaniment, the upward limit will be raised an octave; while by drawing the stopped bass the depth and fulness of tone will be retained.

On an organ of two manuals a whole keyboard is, so far as the construction of the instrument is concerned, available for the accompaniment. But it is, nevertheless, practically restricted to that which can be executed by the left hand; or at any rate, the right hand only assists the playing of the accompaniment in rare cases and with a very considerable tax on the performer's skill. It is accordingly found that the "One-Manual Solo Organ" affords as satisfactory a rendering of the accompaniments found in oratorio and other solos as the ordinary instrument of two manuals, and it possesses, moreover, the considerable advantage that the right hand can readily assist the left by playing many of the notes of the accompaniment in the same way that the hands assist each other in playing four or five part harmony. In this manner the solo part can be played in octaves without deviation from a correct style of fingering, which is precisely equivalent to playing it on an ordinary organ with the manuals coupled.

A consideration of the two specifications of the "One-Manual Solo Organs" exhibited, will show that as regards variety and character of combinations available for solo and accompaniments, these instruments are in some respects almost equal to the two-manual organ of small or corresponding size. A "One-Manual Solo Organ," as seen in the first of the specifications, with one set of special pipes, being about on a par in these respects with an organ having an incomplete swell; while with the two sets of special pipes, as in the second specification, this organ possesses almost equal resources, *as regards combination*, to an instrument of two complete manuals each capable of being coupled to the pedals. It should be noticed, however, that the One-Manual Solo Organ has this disadvantage, viz., that the combinations for solo are, to a certain extent, connected with their corresponding combinations for accompaniment, as indicated by the arrangement in the two specifications given, *e.g.*, in the second the solo combination Nos. 1 (*Salicional*) and 4 (*Dulcet*) could not be accompanied otherwise than by No. 2 (*Dulciana*); still using this latter stop for the accompaniment, the solo might be variously given on Nos. 1 and 4, Nos. 2 and 4, Nos. 1, 2, and 4, or either of these combinations with the dulciana added, as on a two-manual organ coupled. The louder combinations, comprising both sets of special pipes, are, however, more suitable for use with a stronger accompaniment, *e.g.*, Nos. 1, 3, and 5 to the left of the second specification, with which the solo might be Nos. 1, 3, 5, and 7, Nos. 2, 3, 5, and 7, Nos. 1, 2, 3, 5, and 7, or either of these with the open diapason, rohr-flute and celestina accompanying combination in addition. These examples suffice to show the extent to which, notwithstanding the connection before referred to, combinations for solos of various characters and degrees of loudness may be obtained with any desired proportion of accompaniment power.

There is not, therefore, so much restriction on account of this relationship between the solos and accompaniment combinations as at first might appear. Some advantage may be allowed in consideration of the decreased number of draw-knobs it is necessary to move in order to produce a given change in either accompaniment, solo, or both. For example, supposing all the stops of the instrument to be closed, to register each of the combinations for solo and accompaniment above alluded to would require the displacement of no less than seventy-six draw-knobs on a two-manual organ, whereas on the "one-manual solo organ" only forty such movements would be necessary. Since the average number of stops used in these combinations—twelve in number—will probably not differ materially from the average number likely to be required in solo playing, these figures may be taken as representing a reduction of three in the number of movements necessary on any particular or single instance of change in the arrangementof the stops.

With regard to the amount of liberty in playing a solo, the simplest way of putting the restrictions will be to say that in Fig. 45 from *e* to *a* is an ordinary one-manual instrument; from *a* to *c* is the compass available for a solo; from *c* to *e* is the space allowed for the accompaniment of *any* solo, but as long as the solo remains *above* b, or during any pause in it, the accompaniment may be played up to *b*; should the solo be ranging between *b* and *c* then the accompaniment must be kept below *c*. In Messrs. Herbert and Beale's most improved instruments, however, an arrangement has been devised which greatly mitigates the restriction as to accompaniments just stated, and also permits an increase in the solo compass, by enabling some of the keys within bracket B (Fig. 45), to be used for accompaniment even while others are sounding solo notes.

To secure the proper working of the pneumatic action before referred to, in describing the construction, the finger should not be removed from the key when a rest or other discontinuation occurs in the solo part, but should be allowed to remain lightly pressing, without sounding it.

This might be looked upon as a serious difficulty to encounter, but it is found in practice that this extra point in manipulation soon becomes automatic, and as independent of separate attention as does the ordinary fingering of the keys. It must not be overlooked that an organ of this kind would be in a private house, or at most a small building, and that, therefore, it is more than probable that the performers would be to a certain extent familiar with the instrument; whereas, if it were of a size or description to be used for public recitals, &c., where various artistes are coming at random to play thereon, this peculiarity would become far more formidable.

The amount of preparation required is, however, but slight, and in case of a stranger taking the organ, it may be treated as an ordinary one-manual instrument, with some disadvantages in accompaniment.

So far nothing has been said as to the playing of solos requiring portions of the manual other than those within the bracket A (Fig. 44). For the execution of such solos a different arrangement of the instrument from that already quoted is required, which will be found of a less successful character, since it was not thought advisable to incur an increased complication and expense in the construction of the organ for the sake of a class of compositions that would not come within the usual scope of a small instrument, but rather to secure the greatest possible disproportion between the capabilities and the cost of the instrument.

When the Principal and Senza-Principal stops are drawn with a soft 8ft. stop, *e.g.*, the Hohl-flute, the keys within the bracket C (Fig. 45), become an independent manual of the compass indicated as within the bracket B (Fig. 44), with the combination of stops Open Diapason and Liebligh-bourdon. Any solo part comprised within this small compass may, therefore, be played with any accompaniment upon the Hohl-flute or other stop, ranging from the highest note of the manual down to the commencement of the bracket C (Fig. 45); or instead of the soft 8ft. stop, one of the sets of special pipes may be used for the accompaniment, in which case it will have the compass of the bracket A (Fig. 44), and the solo will sound on the Open Diapason only, unless the Stopped has also been drawn. Again, both the soft 8ft. and the special pipes may be used for the accompaniment, if it is not of too full a character, or when it consists of chords introduced between the solo phrases. It must be understood that in using the special pipes as above mentioned, and also for purposes presently to be treated, the *Chords* lever mentioned before is to be depressed, so that no silencing of any pipes will occur.

The addition of the soft 16ft. tone to the 8ft. open diapason for the bass solo, although perhaps unusual, is not a disadvantage, as it gives dignity and prominence to the air. The limited compass available is the real drawback to this arrangement, although the notes of the bass voice below the bracket B (Fig. 44), are not frequently required. The inventors have suggested that in such case the music of the solo should be altered either in regard to position, or that the solo should be absolutely modified by the performer to suit the instrument. This cannot for a moment be entertained as a satisfactory proceeding, but as such alterations sometimes occur in many solos, it must be adopted here as the only means out of the dilemma. That the one-manual solo organ may be of use, and great use, in the performance of such solos as are found in oratorios, &c., we admit; but it is not calculated to answer the requirements of *all* solos—as, for instance, those in modern organ music. Therefore, let the instrument stand as a useful improvement on the ordinary one-manual organ, to be used where there is not room or means for a two-manual instrument; and as such it will doubtless appear to advantage under many circumstances.

In the case where one of two manuals in an ordinary instrument is not complete, the one-manual solo organ holds its own, and perhaps does more; but it can hardly be said to cope with the two-manual instrument.

There is one point that should not be overlooked—viz., that whenever any discontinuation of the solo part occurs, the whole manual may be made available for the accompaniment by simply shutting the Principal stop.

For the other uses to which a plurality of manuals may be put, such as the playing of a duet or trio with a soft accompaniment, the use of the bass in full chords on a weaker manual than the other parts of the harmony, &c., it will be understood that the One-Manual Solo Organ affords the several manuals, combinations of manuals, and variety of registers upon them, that have already been mentioned in connection with solo playing, but that, for such purposes, the "Chords" lever remaining depressed as before stated, the upper limit of the weaker manual will remain at the highest key within the bracket B (Fig. 44).

When it is required to produce the full power of the instrument it is effected by using all the special pipes and depressing the Chords lever; the hands will then assist each other in full harmony playing, and, taking into consideration the increased proportion of stops on the middle notes, as afforded by the special pipes, the power approximates to that of a two-manual organ of small size. The bass is not so full as might be desired, and it has been said that this can be filled in at the discretion of the performer, as is frequently done in small two-manual organs, but without going so far as to comply with any such interference with the music, the one-manual solo organ will be found of very respectable power, and if well managed fairly balanced.

Fig. 46 shows the arrangement of the manual, draw knobs, &c., of a one-manual solo organ, such as shown in the first of the two specifications.

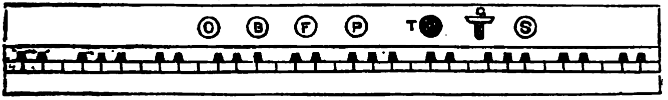

FIG. 46. POSITION OF DRAW-KNOBS IN ONE-MANUAL SOLO ORGAN.

O draws the Open Diapason.
B the stopped bass alone, or puts in O, B, and F by one movement.
F the Holh-flute.
P Dulciana-principal.
T, when drawn, shuts treble of P.
C, when depressed, disconnects action of solo organ, and locks down like swell pedal.
S, when drawn, brings on special pipes, mechanism, and combinations relating to solo organ.

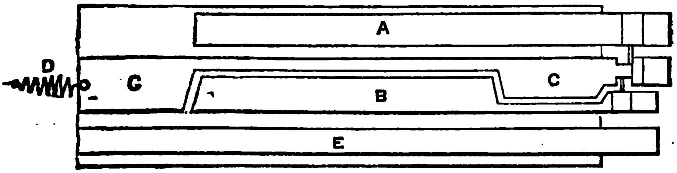

FIG. 47. DIVIDED SLIDERS.

In this instrument is an arrangement called the "*Slide Coupler,*" which in the case of the one-manual solo organ, acts in relation to the drawing of the Open Diapason and Hohl-flute treble, separately or together, but in any case with the bass, as already described. This (Fig. 47) is also interesting as showing the manner in which a sound-board slide can be so divided as to make the treble portion of a stop independent of the bass. This arrangement is not used so much as it was formerly, though on the Continent the practice of having half stops still obtains to some extent. In some cases it is undoubtedly of use, as we see with relation to the instrument now under consideration, as also any *small* organ.

Fig. 47 will sufficiently explain the mechanism as used in an organ under Messrs. Herbert and Beale's patent, in any organ with an incomplete stop or stops.

A is the slide of the Open Diapason to, say, tenor F; B is that of the Hohl-flute, treble, of the same extent (*shut*); and C is the slide of the rest of the Hohl-flute (or stopped bass), opened by the coupler on the drawing of A; E is the slide of the Dulciana-principal; the spring D shuts the bass slide.

The opening of the bass slide without the treble is effected by providing the (otherwise ordinary) draw-stop action of that slide with a locking arrangement, so constructed that the slide is locked *open* when it is drawn *by hand only*, but *not so locked* when it is drawn automatically as above shown. The arrangement of this locking, as also the details of the coupling mechanism, could not be made clear without larger drawings than are available.

We do not think it necessary to give the drawing and plan of the extra sound-board, &c., required for this organ, as the whole is a patent arrangement, and would not therefore be of use to ordinary amateurs. The mechanism is most perfect in effecting those peculiarities that are set forth.

The description of this One-Manual Solo Organ which we have given will sufficiently explain the means by which the cost of adding to an organ a second manual, and doubling the number of stops, and, as a consequence, the magnitude thereof, is exchanged for this novel arrangement, which possesses capabilities for solo playing and some other advantages hitherto only allowed the two manuals. The cost is reduced to about half that of an additional manual, and the room economised is so considerable that it may be said that a One-Manual Solo Organ takes little, if any more space than a one-manual instrument of the same number of ordinary registers.

The building of these instruments has been undertaken by Messrs. Hill and Son, which speaks well for their material and value as to workmanship.

There seems little doubt that in places where a small organ is essential, and money is an object, that this peculiar and novel instrument will make the way it deserves.

CHAPTER XII.

The Couplers and Sforzando Pedal.

IMMEDIATELY on the introduction of the second manual, with the separate pipes and mechanism within the same case as its fellow, the "copula," or, as it is now called, the "coupler," was invented. This consists of an action for bringing a second manual under the control of a single set of keys, so that by playing on the one the effect of using both is produced. The original arrangement pulled down the corresponding unison keys of the second key-board, but since their first introduction various forms of coupling movements have been brought to bear. Some act from one clavier to another, and others on an octave above or below on the same set of keys. A coupler that acts on the note an octave above that pulled down by the finger on the same manual is termed a "Diaocton," and was invented, or rather re-invented, by Mr. Holdich, who has introduced it with great effect into his swells. If the sound-board is made to carry extra pipes, so as to couple the highest keys on the manual to notes in octave, the effect on even a small swell is brilliant in the extreme. A coupler is frequently made to act on the octave above, of another manual, without pulling down the unison note; by this arrangement the swell can be coupled to the great organ, not only in octaves, but also sub-octaves, without increase of the unison tone. The various effects that may by manipulation and management be produced by such an arrangement are almost endless. The power of an organ can be more than doubled by the assistance of a variety of couplers, and in these days of pneumatic action the touch is not made too heavy for the most elaborate execution. Occasionally the couplers that act on notes not in unison with those depressed are so constructed as to command a separate set of pallets, so that the keys themselves of the other manuals are not moved, though the pipes speak. The most usual coupler met with in almost every organ is that which connects one manual to another above it in unison. This would be the "Swell to Great" in a two manual instrument.

Until recently the means provided to effect this coupling was called the "tumbler" movement. But a great objection to its use was, that if brought into action whilst playing on the lower manual there was a tendency to throw the fingers off the keys or disarrange the mechanism. These drawbacks have been overcome by the "gliding" coupler (Fig. 48). It will be seen that here the great organ key, G, has been cut on the upper surface, so as to leave an inclined plane, I, which is covered with leather, and then black-leaded that it may be perfectly smooth. The under surface of the swell-key S is grooved in a like manner, *i*. When not in action the sticker, *s s*, drops into the register, *r r*. The great organ key, G, can then rise without coming into contact therewith. When in action, the register, R R, is carried backwards to the position it assumes to the right of the figure. The sticker, *s s*, glides up the inclined plane, I, is raised slightly out of the register, R R, and brought under a button, *b*, and thus lifts the swell key, S. The back part of the sticker is so bevelled that should the coupler be drawn when a great organ key is down, the sticker may raise the swell key by degrees without any sudden jerk. A tapped wire, *w*, passes through the swell key and regulates the action of the coupler to a nicety.

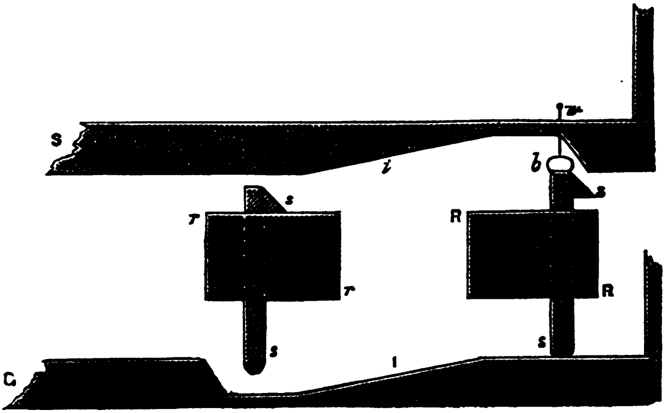

Fig. 48. The Gliding Coupler.

The same contrivance is used to couple the swell or the great organ to the choir in unison. An octave coupler affecting notes of another keyboard may either be made to act on separate pallets of the soundboard, or by means of backfalls on the ordinary key action. In the former case the keys would not be pulled down when the coupler is brought into play; whereas, in the latter instance, if not specially weighted, the notes of the coupled manual would descend. The same holds good with regard to the sub-octaves.

The coupling of the pedals to the manuals is accomplished by the aid of rollers, backfalls, and stickers. The rollers are required to bring the pedal note under that corresponding to it on the manual, and this portion of the action being accomplished, a backfall (B Fig. 49) runs parallel to the manual key, A A. From the end of this backfall a sticker, *c c*, rises, supported in a frame, *d*. When the manual is not coupled, the sticker frame is in such a position that the tail of the key, A, is just free, and in front of the sticker, *c*, as in Fig. 49; but by drawing a knob attached to suitable mechanism, the frame, *d*, is put slightly forward, and the sticker, *c*, is placed immediately under the key, A, as shown by the dotted lines.

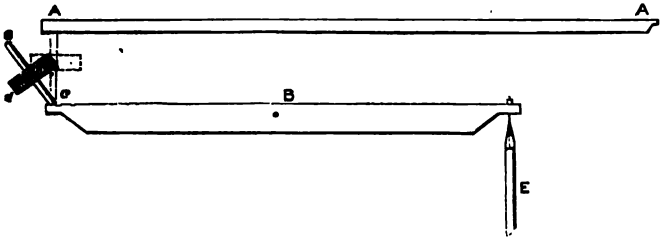

FIG. 49. THE PEDAL COUPLER.

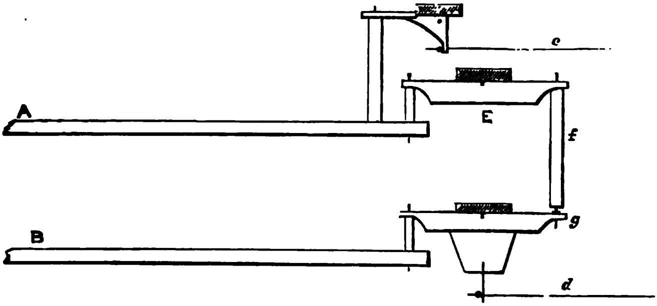

FIG. 50. SFORZANDO PEDAL.

When the pedal key is depressed, the tracker, E, pulls down the backfall, B, raises the sticker, *c*, and with it the tail of the manual key, A A, This same action may be used for all unison coupling of the pedals to a manual, a separate set of stickers being required for each distinct clavier with which the connection is to be set up. Couplers are frequently made to bring notes of a different pitch on the manuals in connection with given notes on the pedals. Thus a CC pedal may bring down a tenor C of the manual, and by so doing obtain the effect of as many 4ft. stops on the pedal as there are unison or 8ft. stops drawn on the manual during the time of coupling. Another useful coupler is that which causes the pedals to act on various octaves of their own clavier, as when the CC key brings down the C with it, or the C key brings down the CC.

The *sforzando* pedal is a coupler of great value. It is an arrangement for bringing the power of the great organ on to the swell manual instantaneously by means of a pedal. Occasionally, where there is a sub and super-octave coupler acting on the swell organ, these are brought on instead of the great, and inasmuch as then the whole reinforcement is again under the influence of the ordinary swell pedal, this method is perhaps the better. Fig. 50 shows the mechanical contrivance for bringing the great organ under the control of the swell keys. This is accomplished by means of a backfall, E, which rises and falls on the sticker, *f*, and thus connects the action of the swell tracker, *c*, with that of the great tracker, *d*; the upper pin of the sticker is free, the under one being regulated by a button, *g*. On depression of the swell key, A, the backfall, E, will so act on the sticker, *f*, that the tail of the great organ key, B, is lifted. A spring brings the pedal back into its original position when the foot is removed, and moves the backfall, E, from its bearing point on the sticker, *f*.

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CHAPTER XIII.

Composition Pedals or Shifting Movements.

WHEN a considerable number of stops differing in character were placed on the same manual, a difficulty arose in so adjusting the draw-knobs that they might be immediately under the control of the performer, in order that an instantaneous change from loud to soft music, or *vice versâ*, could be effected. This was more especially felt in small organs having no echo. Both Smith and, after him, Snetzler met this defect by having a pedal so arranged that on its depression all the louder stops were silenced, and with its release were brought on again. As a rule this pedal would take off whatever mixture might exist, together with the reed, and any flue stops under 4ft. tone. The pedal was held down in a notch, and was brought back by a more or less powerful spring, which was made to act on the sliders that were in connection with the mechanism or on the pedal itself. Such a contrivance remains as Snetzler left it in the organ at St. Decuman's, Somerset (*vide* Part I., Chap. IV.), which in this case acts on a cornet, sesquialtera, and fifteenth.

The modern composition pedals or shifting movements are an improvement on the spring pedal, and are attributed to the late Mr. Bishop. At first each pedal was constructed to perform one function only, *i.e.*, to pull out or draw in a given number of sliders. These were termed single-action composition pedals. The spring, which, in the original arrangement of Smith's time, threw the sliders into their former position, was dispensed with, so that if a pedal drew out knobs 1, 2, and 3, another pedal or the hand was required to replace them. These single-action movements have been entirely superseded by the double-action pedal, which finds a place in all modern instruments. These are so constructed that each pedal not only draws out given stops but at the same time pushes in all others, so that by a single movement the organist is sure of obtaining one individual combination, whatever the condition of the sliders may have been previous to the transition. Supposing three pedals to act on the sliders of the great organ; if all the stops are in, and the first pedal be depressed, the diapasons and principal would be drawn; on the action of the second pedal, the metal flue stops up to the fifteenth would be added with perhaps a thin mixture, the third pedal would bring on the full mixtures and reeds. If all the stops are drawn and the first pedal be pressed, all stops except the diapasons and principal would be silenced.

As a rule, organs of moderate size are now provided with at least four double-action composition pedals acting on stops of the great manual, the first giving a soft organ of, say, stopped diapason and dulciana, the second rising to the principal, the third to the small flue stops with the quint, and the fourth commanding the full organ. It is also usual to have three or more of these pedals acting on the swell, especially where there are many stops in this department. In large two-manual instruments it is more than ever necessary to have well arranged composition actions, that the choir and soft organ effects can be promptly brought to bear; in fact, these movements in a great measure palliate the absence of a choir manual for soft accompaniments, though the advantage of the extra clavier for solo effects needs no comment.

The shifting movement has been applied lately to large organs in an extremely useful manner. Under each manual, and well within reach of the thumbs, are placed a number of buttons acting by pneumatic agency on the sliders after the manner of the composition pedals. The mechanism, as far as the pneumatic arrangement is concerned, is a modification of that in use for regulating single sliders (*vide* Chap. IX.) The advantages of this plan are manifold; for not only is a mere touch sufficient to rearrange the stops, but the performer has each button in sight, and these being immediately under the manual they influence, there is no tendency to confusion of relationship.

The ordinary mechanical shifting of the sliders can be effected in so many ways that each builder chooses a method in accordance with his surrounding work; and it is here again frequently a matter of the individual peculiarity of an instrument that will decide which is the best mode of procuring the desired result. Fig. 51 shows a very useful form of action. The sliders, S S, *s s*, are attached by the armlets, *a a*, to the rods, *r r*, R R, which are fixed so as to revolve on their axes. The crank, C, is connected to the rod, *r r*, and by the projecting irons, *p p*, acts also on R R. When the pedal, P, is put down the rod, *r r*, is turned forty-five degrees, and the sliders, S S S, are thrown in, whereas the rod, R R, is forced forty-five degrees in the opposite direction by the projecting irons, *p p*, and the sliders, *s s s*, are drawn out.

The rods are of iron, and therefore take little space, so that a number may be fixed close under the sliders; another pedal would, of course, act in the same manner on different sliders. This action is usually placed on the opposite side to the single draw-stop mechanism,

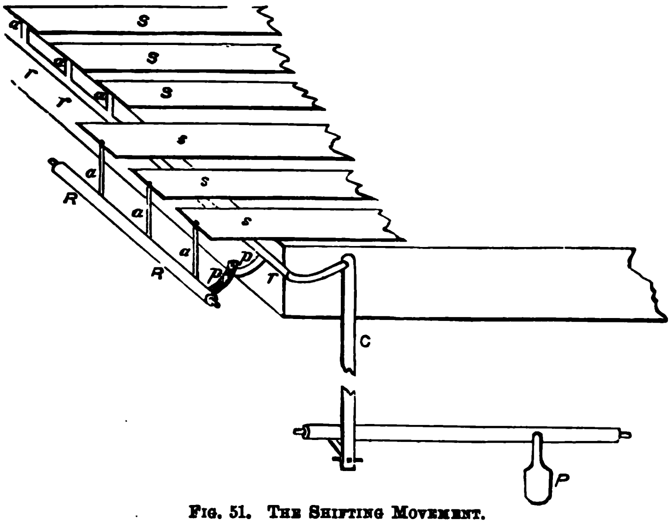

FIG. 51. THE SHIFTING MOVEMENT.

so that the position of the slides is reversed in appearance, and those which project from the soundboard are silent, whereas those that are apparently shut are open.

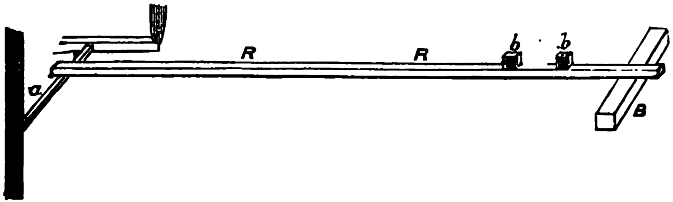

FIG. 52. WOODEN SHIFTERS.

There is a clever way of adapting composition action without additional connection with the sliders, though it can only be added to organs with the wooden trundle draw-stop action, unless the iron trundle is specially constructed to receive it.

A rod of wood (E, Fig. 52), is fixed to the upper arm, *a*, of the ordinary trundle action, and, running across the organ under the soundboard or in a convenient position, is allowed to rest on a beam, B. On the rod, at suitable intervals, are fastened two blocks, *b b*, which are pushed in either direction by arms, from iron rods above, governed by a pedal, as in Fig. 51. It is sometimes an advantage to add this action to an organ to avoid interference with the sliders themselves, which in old organs are often too short for further attachments.

The composition pedals are usually placed in a row immediately above and in front of the ordinary pedal keys. Sometimes they may appear at the sides. They are, as a rule, so arranged that those acting on the great organ are to the right of the ones which affect the swell. It is much to be regretted that no order has been fixed as to the side on which the loud or soft pedals should be always placed, so that now one builder places the soft pedals where another places the loud. We have found that in the majority of later organs these pedals increase in power from left to right.

It would be impossible to give all the shifting actions used by builders. Circumstances have from time to time suggested many forms of this mechanism to meet peculiar cases, and the ingenious artificer will never be at a loss to find a way of making cranks and levers, squares and rollers, subservient to his desires.

* * *

CHAPTER XIV.

The Tremulant and Swell Pedal.

FROM a very early period in the history of the organ the tremulant, under various forms, has been known and utilised by builders. Loosemore put a "shaking stopp" in the organ he built for Sir George Trevelyan. Seidel speaks of the "Tremolando" as imitating the "sobbing, sighing, and trembling of men;" and the introduction of some such effect in the early organs was not uncommon. On the other hand, it is only recently that the action has assumed a guise which renders it useful in modern compositions. Originally it was an extremely noisy, clumsy, and unsatisfactory affair. In Loosemore's organ it affected only the lowest octave of a reed stop which met "the trumpett," and in the organs of the seventeenth century it was of a coarse and harsh quality. Practically, therefore, the tremulant was of little value and gradually fell out of use, until, having been revived and improved by the French, it is now generally found in modern organs, and when judiciously and not too frequently brought into play, it is of great use to the organist.

The trembling is brought about by an apparatus that agitates the wind in its passage through the wind trunk. This action, therefore can be introduced into any or every department of an organ, but it is found of most service in conjunction with delicate stops in the swell. There are several methods of constructing tremulants, but they are all more or less on the same principle. Fig. 53 represents one form which is frequently used. The whole arrangement is fixed on the side of the wind trunk. The wind passes through a hole into the reservoir, R R, and thence through an orifice in the slab, S S, into the tremulant, T T, this having an aperture, closed by the pallet, P, which is held in place by the screw C. To bring it into action the screw is turned half round by means of draw stop or pedal mechanism attached to the arm, E. The pallet, P, being raised, the tremulant, T T, also rises, but is at once repelled by the spring, I, which is arranged to exactly balance the pressure of the wind within the tremulant. The continual battle between the wind pressure and the spring causes an oscillation, the rapidity of which can be accelerated or retarded by moving the weight, w, attached to a bar on the tremulant. The vibration thus set up is imparted to the speech of the pipes.

In many large instruments a tremulant is made to act on the choir organ, in addition to one on the swell; frequently also only certain suitable stops are in connection with this action, such as soft reeds, &c. The vox humana, for instance, is now seldom used without the addition of the tremulant.

There is a great deal to be said for and against the universal adoption of this accessory. We think that, used in moderation, it has a pleasing effect, and in soft interludes of a few bars' duration it appears to advantage. Unfortunately, many performers get into a habit of using this, as well as the vox cœlestis and such exceptional registers, more than is either justifiable or pleasant. We often notice that the harmonic flute, or any such *piquant* stop a small organ may contain, is used *ad nauseam* by inexperienced or young players; but this cannot be urged as an argument against the appearance of any such stops in the instrument. The same holds good with regard to the tremulant; and as the latter is by no means an expensive item, we see no valid reason why it should not appear in any organ, except those small instruments used only for accompaniments. It is true that attention is occasionally required to the adjustment of the weight and the free action of the pallet; but this is of so simple a nature that the organist can easily overcome any such difficulty that is likely to arise.

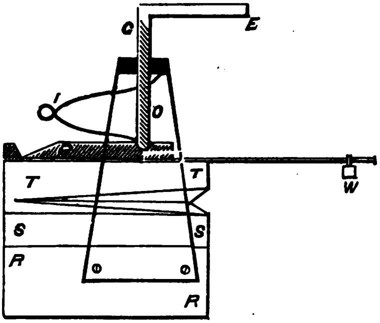

FIG. 53. THE TREMULANT.

The *crescendo* and *diminuendo* effects of the swell are produced by the opening and closing of shutters, in describing which it will be necessary to revert to the original "echo organ," of which our modern swell is the offspring. The "echo" consisted of several stops on a separate soundboard, enclosed in a box, and commanded by a distinct clavier, rarely if ever extending below middle C. In the year 1712 Jordan improved upon this by inserting into one side of the box a sliding shutter, and the term "nags-head swell" was given to this arrangement of what was then known as "the swelling organ." But there were many drawbacks to the contrivance, for, though the shutter was balanced by weights, like the sash of a window, it yet required considerable force to start it, and when once moved, it was difficult to command its position by the foot with any degree of certainty. It is to Green that we owe the Venetian swell, which took its name from the resemblance it bears to the Venetian shutter. That builder not only effected this improvement, but he fully appreciated the value of this department of the organ, and increased the compass, as low in some cases as gamut G, for until his time the swell never went further than fiddle G, or at most tenor F.

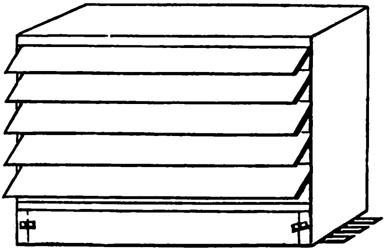

FIG. 54. THE VENETIAN SWELL-BOX.

The Venetian swell has been adopted in many forms. In the majority of cases it is usual to have the front of the swell-box divided into horizontal shutters, as shown in Fig. 54, so constructed that they remain closed unless influenced by a pedal, connected therewith by a more or less simple mechanism, generally a lever. When necessary the shutters are balanced by a weight, which takes the burden from the performer, as it is essential that they should be commanded without the least effort on his part. If the shutters are made too narrow, the sound is more or less impeded; but again, if they are made too broad, they become unwieldy and are also apt to cast.

In order to produce a more effective *crescendo*, it was suggested that one set of shutters should be placed within another, and by suitable appliances they were opened in succession, but the idea has been abandoned on account of the complication necessary for the small advantage gained. M. Cavaillé Colle uses vertical shutters, which are kept tight by a spring; in some cases he has enclosed the whole organ by such means. Mr. Hill invented an ingenious device, which has been adopted in the organ in Westminster Abbey, and answers very well. He so constructed the shutters that they should open both ways, *i.e.*, half should open inwards and half outwards, and thus a more pronounced *sforzando* can be produced, and less impediment is left to the egress of sound when the swell is entirely open.

The swell box should be coated with thick brown paper, and then glue, in order that it may be thoroughly air tight and keep in the sound; it therefore follows that if a number of pipes are speaking within the enclosed space, the pressure occasioned might become sufficient to affect their pitch. This difficulty has been met in some cases by inserting a tube like a wind trunk into the back, or some convenient part of the swellbox, the outlet of which is in some remote chamber or on an external wall. To prevent the admission of a colder atmosphere, or the deleterious effect of damp through the tube, a valve is placed at the end, which on the opening of the swell shutters immediately closes, but remains open on their release. But the exigency has been overcome in a far more scientific and satisfactory manner by Mr. Willis, who in large organs places the bellows supplying the swell within the box, so that the wind is continually taken from the enclosed space, and thus all undue pressure is at once relieved.

Under all circumstances, when the organ is not in use, the swell shutters should be left open, the pedal being hitched down in a notch made to catch it; the reason for this is, that if the swell be shut, and the temperature on the outside changes, the pipes within not being subject so immediately to a similar variation, would not be affected as their external neighbours, and so would not be in tune with them. Pipes to go together should be kept under similar conditions, so that on no account is it advisable to subject one portion of an organ to influences not common to the whole. Beneath the lowest shutter of the swell-box there is placed a movable panel for access to the reeds, which necessarily require most frequent attention, and are therefore placed in a position to come within reach of the reed-knife. The flue pipes are gained either by a door, or a sliding board on either side the swell-box. In large swells, passage boards are arranged as for other portions of the organ, with an entrance door at the back.

If the swell is a great distance from the console, as in the case of electric organs, or where there is much weight to be overcome in opening the shutters, it is advisable to bring pneumatic agency to bear on the lever; and it will be obvious that a power capable of opening a number of sliders at once will be sufficient to perform the part here required. The late Mr. George Cooper, organist of St. Sepulchre's, Snowhill, had a connection set up with the chair on which he sat, so that on leaning back the swell was opened. We are not aware that this contrivance has been carried out in any other instrument; indeed, it appears clumsy, and necessitates a back to the organ stool, which is not found advantageous.

Instruments of one manual, for chamber use, are sometimes entirely enclosed in what is called a "general swell." Some builders deprecate these, but there appears no sort of objection to this addition, for it gives further scope to a small organ, and the shutters can be fixed open under ordinary circumstances.

CHAPTER XV.

Material for Organ Pipes.

In the first chapter of Part I. we mentioned that organ pipes were made of lead, brass, and copper; and again, in Chapter VI., we went on to say that they had been formed of alabaster, silver, and pasteboard, but we cannot do better than once more quote Seidel, who, in a brief paragraph, says that "gold, silver, brass, copper, alabaster, glass, clay, and even paper" have been used for this purpose. Dom Bedos states that occasionally diapasons were constructed of ivory instead of wood. The very early writers on the subject fail to mention wood, so we must conclude that the few pipes required were all of some metal.

In the present day pipes are constructed either of wood or metal; of the former it may be observed that pine, cedar, deal, and mahogany have taken the place of oak, pear tree, and maple. It is admitted that oak is a first-rate wood for the purpose, but the expense of working it has almost, if not entirely, excluded it from the workshop. We saw how careful Father Smith was in the selection of his material, and in these days the same caution is necessary. Where knots are absolutely unavoidable, they are glued over and covered, or they are entirely removed and their places blocked. There is a great deal of old wood work still extant by the early builders. Thus, in one of Loosemore's organs the pipes are still in first-rate condition; and, again, in Hereford Cathedral there is a stop diapason on the great organ, and the bass of a similar stop in the choir, by Harris. So much advance has been made in the art of voicing that in modern building wood has gradually given place to metal, for almost any degree of tone can now be produced from pipes of the latter material. Therefore, under ordinary circumstances, only a very few stops, if any, are made of wood throughout their entire compass, if we except the larger stops of the pedal department. It is usual to coat the interior of wood pipes with thin glue, that all the pores may be filled and the quality of tone by this means enhanced; and, further, many builders red-size their pipes on the outside.

Of all the metals that have been used in the manufacture of pipes, English tin stands pre-eminent. Strange to say, the German builders of the eighteenth century discovered its value before it was appreciated in this country. Seidel speaks of a compound of English tin and lead, which a translator has graphically described as pewter. Within the last thirty years tin has gradually become recognised as by far the best material of which pipes can be constructed. There are various foreign tins in the market, and they have all been utilised for pipe making, but none of them equal our own in value. The reasons that combine to place this metal in such esteem are manifold. The specific gravity of tin is 7·3, whereas that of lead is 11·3, but not only is tin lighter than lead but it is less pliable, and need not, therefore, be made so thick, so that it is capable of retaining its own weight for an indefinite period. It is again sufficiently tough to withstand the action of the tuning horn without splitting, and this is an advantage that can hardly be overrated. In point of appearance there is no comparison between this and any other available metal. It does not lose its lustre in ordinary temperatures in either dry or moist air, and is able to resist the attacks of carbonic acid and other noxious vapours arising from the use of gas, the presence of a large audience, &c. Tin does not so easily corrode at the points where the pipes come in contact with the rackboards and upper boards as do other metals, but it is a mistake to imagine that it entirely ignores the action of the ordinary acids. Another advantage that is of great importance rests in the superior resistance which tin offers to changes in temperature. It is not subject to the same degree of expansion and contraction as lead; pipes, therefore, of tin keep well in tune.

There is some difficulty in joining the seams of pipes of pure tin, so that almost all builders, as a rule, use a very small quantity of alloy—generally lead—even in their purest work. A distinction is made between "tin" and "pure tin." The former term has been used for any proportion where the alloy does not exceed a fourth of the entire substance in weight. The great drawback to the general adoption of this metal has been its high price as compared with the others; at the present moment it is lower than it has ever been, though it is still far more expensive than lead.

"Spotted metal" is the name given to a compound of tin and lead, in the proportion of one-third of the former to two-thirds of the latter. It is so called because on the cooling of the sheets after casting blotches "rise" on the surface, and give to them a mottled appearance. This combination has been in use for many years, and is still held in great repute, and is to be found in the works of almost every modern builder. If any other proportion of the metals be used, these patches do not appear, so that the reputation that spotted metal has gained is owing to the fact that it carries on its face proof positive of the percentage of tin it contains.

"Metal" is a term used in the trade for any compound of tin and lead. The proportions are arbitrary, it therefore is impossible to rely on this title as definite or distinctive of any class of material.

Lead has been largely used in the manufacture of organ pipes. It is now seldom if ever found without some proportion of tin or other metal being mixed with it. The objections to the use of pure lead are principally on account of its great weight. Being soft, it must necessarily be of considerable thickness, and the body of the pipes then become so heavy as in course of time to crush their feet; in some instances enough to displace the languid, and frequently sufficiently to affect their speech. If used in reed work it will sometimes cause the whole tube to bend over at the socket. The Germans occasionally made their metal work of lead, and in some of the remaining specimens of the old English builders lead pipes are found that have quite crushed their feet. This is the case in the organ at Chelmsford, by Crang and Hancock, where almost all the lower octaves of the flue stops have suffered. Lead is oxydised in moist air, and therefore does not retain its brilliancy in our climate.

Antimony has been used in conjunction with lead, as also has "type metal," and although the addition banishes the necessity for great thickness of pipes, the mixture is so brittle that it is apt to split at the top after a few tunings; sometimes reed pipes of this material have been known to break off altogether.

Zinc has of late years been turned to great account for the larger pipes, those of the 32ft. octave being frequently made of this metal, as also are the pipes in the pedal department of large instruments. It is cheap, light in comparison with lead, its specific gravity varying from 6·8 to 7·2, and it is sufficiently tough and hard to obviate the necessity for undue thickness. Lastly, it is not affected by damp or change of temperature in any very marked degree, and therefore pipes of this material stand well in tune.

The foregoing metals and compounds do not under similar conditions produce the same tone, and a word must be said here on this subject, as far as it may be influenced by material. The experienced voicer has more at his command than is generally supposed, and there is not so much depending on material as on shape, calibre, voicing, and weight of wind, combined. Nevertheless, two pipes of equal proportion, and voiced in precisely the same way, would produce different gradations of tone, and, all things being equal, the following may be taken as generally admitted facts.

Pure tin produces a somewhat piercing tone, unless allowed an especially light wind, and therefore, where this is not required, a compound containing some proportion of lead is used. Spotted metal gives a full round tone, and is superior therefore in this respect to tin, at any rate, for the large scale flue work. Lead wants the brilliancy and ring of the foregoing materials, and is somewhat dull. Other mixtures may be said to vary according to their composition.

Zinc is only used for the larger pipes, and when well voiced possesses a very grand full quality of tone, and is in every way fitted to the purpose to which it is applied. The thickness of the metal has also some influence on tone, and it is found that the thicker the substance of a pipe is made the more round and satisfying is the effect produced.

Good or bad pipe material can be detected in a number of ways. The experienced eye needs little to assist it. Dark blue looking pipes usually have a preponderance of lead. Lead pipes, again, when tapped with the nail give a dull sound; they will soil the hand or a white handkerchief if rubbed, and they are easily scratched. The reverse of all this is noticed in tin work, and spotted metal can never be mistaken.

A great deal depends upon the choice of metal in building organs. We repeat that the voicer holds the tone and the speech almost entirely in his hands, but durability and actual lasting worth are dependent on the metal chosen. Spotted metal is always advisable, and we think that it is a mistake to imagine that much is gained by having a higher percentage of tin in metal work than is here obtained, except for special registers, as choir salicets, orchestral oboes, gambas, &c., and stops of sharp intonation.

For an accurate description of the way in which the metal is worked up we must refer the reader to larger works on the subject. Dom Bedos enters fully into this subject, and gives some very interesting engravings, which show us that little alteration has been effected since his day. Suffice it to say here that the metal is cast in shallow troughs into sheets a little thicker than the actual calibre required, and having been planed smooth after cooling, is cut into strips of a suitable width. The way in which wood should be prepared was described in the first chapter of this division, page 40.

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CHAPTER XVI.

Different Forms of Organ Pipes.

ORGAN pipes are divided into two great classes, viz., "flue pipes" and "reeds." Flue or mouth pipes are dependent for their sound on the vibration of air within their body or tube. The greater the number of these vibrations the more acute is the sound produced, and conversely. The celerity of vibrations depends upon the length of the column of air within the pipe.* One column half the length of another makes twice the number of vibrations in the same time, and one column double the length of another makes half the number of vibrations in a like period, *i.e.*, provided the diameters and weight of wind, &c., are equal. The effect of "stopping a pipe," or closing the upper end, is to decrease the number of vibrations by half, so that a stopped pipe of given length produces the same sound as would one twice its length if open. The lowest note appreciable by the human ear as a musical sound is produced by sixteen vibrations in one second, and is the note given by the 32ft. open pipe, viz., C C C C; the highest note we can distinguish is produced by sixteen thousand three hundred and eighty-four vibrations per second, and its musical name would be C^7. Some idea of its pitch may be gathered from the fact that it is four octaves above the highest note of the foundation tone of the Regent's Park organ, or no less than ten octaves above the lowest note C C C C.

The vibrations are set up in organ pipes by forcing the wind through a narrow passage or "wind way" behind the "lower lip" (A, Fig. 55), so that on emerging the stream is split by the "upper lip," B, some going inside the pipe and the rest escaping. The opening between the lips of a pipe is called "the mouth;" that portion below the mouth is called "the foot," C, and all above "the body," D. The reed pipes, on the other hand, do not depend upon the length of their tube for the pitch of the sound they produce, but upon the vibration of a metal tongue or "reed," a further description of which, as also of the individual parts of flue pipes, will be found in the next chapter.

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* This is not absolutely the case, but practically it comes to this as far as organ pipes generally are concerned.

Pipes have varied in design and shape ever since a distinction in tone or calibre of sound became appreciated or attainable; and by reference to old works on the subject we find that the early builders were fully alive to the advantages gained by variation of form, which affected the tone of the registers they employed. The engravings in the work by Dom Bedos show us that the main features of the stops then known and used differed in no very marked degree from similar ones of the present day. Fig. 56, A, is a reduced copy of a Stopped Diapason taken from the above-mentioned work, and it points to a care and finish that would bear comparison with modern achievements. The German builders of the last century were given to constructing pipes, especially reeds, of very curious form, of which B and C (Fig. 56) are specimens; B represents an Apple or Button Regal, a reed stop now no longer used, the pipes of which were very short; C is a "Bear's Pipe," described

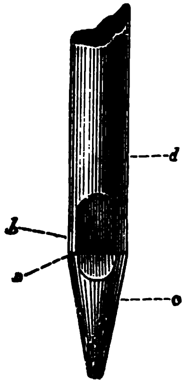

Fig. 55. Metal Flue Pipe.

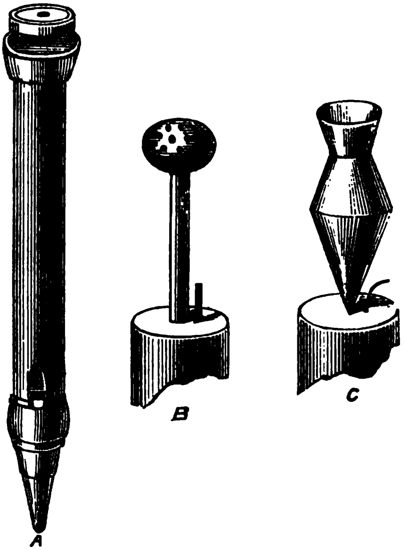

Fig. 56. Obsolete Forms (Dom Bedos).

as "a reed of soft intonation." The tubes varied in form throughout its compass, and some of them are said to have resembled in shape the Vox Humana in the Temple organ, by Father Smith.

In the present day pipes may be divided into the following groups, having reference to outline:

Wood	1. Four-sided	Open. Half-stopped. Stopped.
	2. Three-sided 3. Pyramidal 4. Inverted pyramidal	Open.
Wood Metal	5. Cylindrical	Open. Half-stopped. Stopped.
Metal	6. Conical 7. Inverted cone 8. Conical, with bell 9. Inverted cone, with bell	Open.

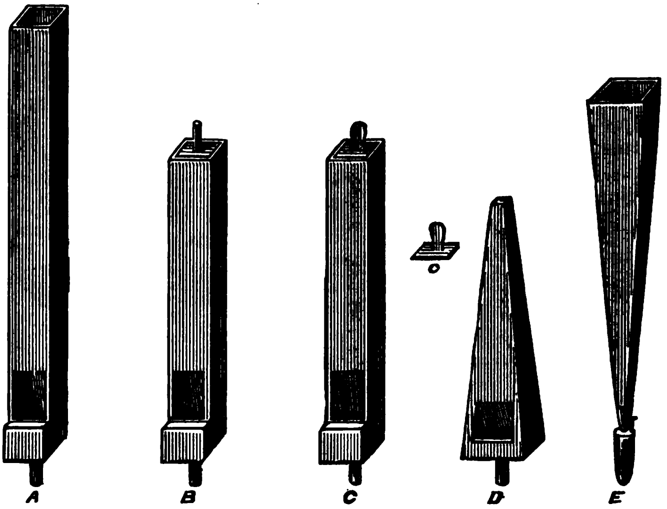

FIG. 57. VARIOUS FORMS OF WOOD PIPES.

There are a few uncommon pipes which escape this list, but for all practical purposes it is sufficient. For convenience of description we shall follow the order above taken.

Four-sided pipes are invariably of wood, and are, as the table shows, divided into three groups—open, half-stopped, and stopped.

Open pipes of four sides (Fig. 57, A) are to be found in almost any organ; in small instruments they frequently form the bass of the Open Diapason, and some of the flute work is constructed of these, as also is the Claribella. The Open Diapason, 16ft. on the pedal, is always of this shape when made of wood.

Half-stopped four-sided pipes (Fig. 57, B) are by no means so common as the foregoing. They are closed at the top by a stopper, through which a small hole is bored, or a tube inserted. Some flutes are of this description, and the treble of the Stopped Diapason is occasionally so made, but the practice is not extended to the larger pipes in any instance.

Stopped pipes of four sides (Fig. 57, C) are to be seen in all old organs, and in nine-tenths of the modern ones. They resemble the open in shape, but are closed at the top by a plug, *c*. The Stopped Diapason is usually of this kind, and in the smaller instruments the bass of the Dulciana, Viol-di-Gamba, or any soft stop is often continued below tenor C with these pipes. The Bourdon is always made after this pattern, except in a few modern instruments, where it is of metal. The Double Diapason, unless otherwise specified, is also always made of this shape.

Three-sided pipes are comparatively rare, and appear to have no special advantage over those of four sides. Messrs. Forster and Andrews have placed one in the organ they erected at Halifax.

Pyramidal pipes (Fig. 57, D) occur as the bass portion of the conical stops, as, for instance, in the case of the Gemshorn.

Inverted pyramidal pipes (Fig. 57, E) are much used for the large reeds, especially in pedal organs, where the tubes of the 16ft. and 32ft. are usually made of this shape when not of metal. The Bombarde in the organ at the Pro-Cathedral, Kensington, is of this description. Sometimes 8ft. reeds are so constructed, an instance of which occurs in the organ built by the late Mr. Hill for the Wesleyan Chapel, Poplar, where a Bassoon on the choir is of this character.

Cylindrical pipes form the staple of all organs whatsoever. They are marked in the table as being of wood and metal. This is so in point of fact, though we may dismiss the former by saying that now-a-days, only rarely in Germany is a delicate kind of flute made of wood in this shape.

Open cylindrical pipes (Fig. 58, A) go to make up by far the majority of stops on an ordinary organ. The Open Diapason, Principal, Fifteenth, and all Mixtures and mutation stops are of this type. The Keraulophon, Dulciana, harmonic stops, and some of the more delicate reeds, as, for instance, the Vox Humana and Clarionet, also belong to this group.

Half-stopped metal pipes (Fig. 58, B) are not uncommon in English organs. A small tube is made to pass through the ordinary stopper. The French stop, "Flute à chèminée," takes its name from this peculiarity in make. Some of the old metal flutes are also found of this form.

Closed cylindrical pipes (Fig. 58, C) are not nearly so common, for until recently builders have used wood in preference to metal for the

CHAPTER XVII.

Construction of Pipes.

To understand thoroughly the various parts of a pipe, it is essential to master the principles on which the sound depends, and to appreciate the several functions performed by each individual portion, in order that the desired result may be brought about.

It was seen that flue pipes were dependent for their sound on the vibrations within their bodies, and, going a step further, these vibrations are set up by others which occur at the mouth. The mouth itself, therefore, is only a means to an end, and is not essential to the sounding of a pipe *per se*. This is demonstrated by allowing a small stream of hydrogen to burn in an open tube; the combination of this gas with the oxygen of the atmosphere sets up a series of vibrations within the tube, which produce a musical sound in accordance with its length. In organ pipes, when the air is forced through the "wind-way," the stream is directed against the upper lip. This "sheet of wind," as it is termed, is under several influences. The air that comes out of the mouth of the pipe, in passing upwards, causes a draught underneath with an inward tendency; now, the sheet of wind from the wind-way is exposed to this from the outside, whereas the walls of the pipe guard it from the opposite direction, and therefore a varying pressure is caused, the air within being insufficient to counteract the inward draught, the sheet of wind gives way momentarily, but being the stronger, immediately supersedes, and thus a continual oscillation is set up, and is communicated to the column of air within the pipe. It must be distinctly remembered that the pipe itself does not vibrate. If it did, the calibre of its material would alter the pitch of the note produced; but such is not the case, the quality of tone and not the pitch being only affected by this circumstance.

An interesting exception to the above is observed in connection with four-sided pipes, that whereas in these the backs and fronts remain motionless, the sides are subject to considerable vibration. The reason that a closed pipe produces a tone equal to that expected from an open one twice its length, is that the column of air within the body has to pass up to the top and *down again* before it can make its exit, and is therefore in reality as long again as the pipe which contains it.

It is found in organ pipes that if they are made very narrow in proportion to their width of mouth they do not speak the note apparently natural to the length of body, but the octave, or some other "harmonic," the reason of which is that the vibrations at the mouth are too rapid to correspond with those that the tube requires; the column of vibrating air, therefore, at once splits into two divisions, and renders the note natural to the lengths into which it has been forced to divide.

This is again exemplified if a pipe of ordinary dimensions is overblown, the tendency is then to increase the velocity of vibrations at the mouth, and an harmonic sound, consequent on division of the column, is the result. M. Cavaillè Coll has introduced harmonic stops into the organ and utilised this law. He accomplished the perfect and rapid speech necessary by boring a small hole about the middle of the body of narrow scale pipes, constructed for the purpose; an equal division of the column within was the result, and the desired octave was produced. It is due to M. Coll to give him all praise for his invention, and his practical application thereof, but many years previously Sir Frederick Ouseley had worked out the idea and written privately on the subject.

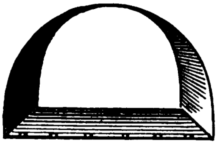
FIG. 59. THE LANGUID.

In point of fact, all flue pipes are constructed on the same principle, and have the same component parts, but the differences of shape and material have led to a distinction in nomenclature. Besides the "body," "mouth," and "foot" described in a previous chapter, a metal flue pipe contains a "languid" or "language" (Fig. 59); this is a flat piece of metal that is placed immediately over the foot, within the mouth; it is soldered firmly by its sides and back, having no other support; it is of thicker calibre than any other portion of the pipe, its solidity and stability being of the utmost importance. It presents in front a straight edge, which is parallel to the lips of the body and foot, and this edge forms the back boundary of the "wind-way," which is the opening allowed between the languid and the lower lip. Any movement of the languid would at once alter the direction of the sheet of wind, and seriously affect or altogether stop the speech of the pipe. This is why the strength of the languid is of such great importance.

Metal flue pipes are often furnished with "ears," and in the case of some stopped and half-stopped pipes they assume considerable size and importance. They are said to keep the wind together, as it were, and direct it more surely against the upper lip. They are therefore useful where a pipe may be "cut high" and there is any fear that the wind may not "reach." In some cases, especially in old work, pipes are tuned by long ears made for that purpose; in ordinary open flue pipes they are small, and add a neatness and general finish to the appearance of the stops in sight.

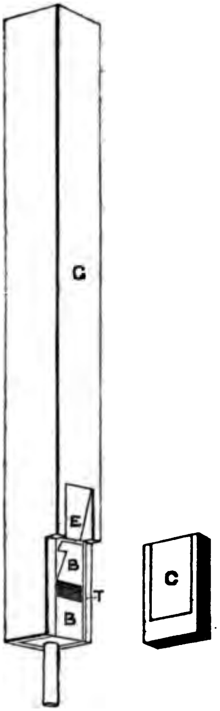

FIG. 60. WOOD FLUE PIPE.

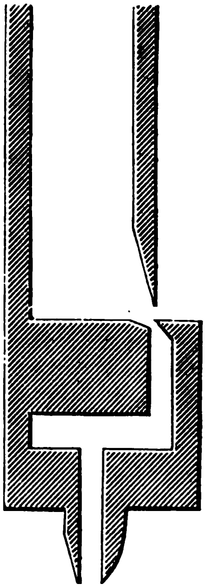

FIG. 61. SECTION OF WOOD FLUE PIPE.

Wooden flue pipes are made on precisely the same principle as are those of metal. But their shape has necessitated some modification of particular parts, and hence a distinct nomenclature has sprung up in relation to these pipes. The "body" is a rectangular tube, the cross section of which is usually oblong; at the lower end it is closed by the "block" BB (Fig. 60), which takes the place of, or rather is, a modified languid. This block is cut deeply to form the "throat" T (Fig. 60). Both the throat and block are covered by the "cap" C (Fig. 60). The wind-way is formed by the upper end of the cap being bevelled away. The "foot" is a short tube which acts as a support to the pipe, and conducts the wind thereto.

The mouth of a wooden flue pipe is made by discontinuing the front of the body, above the block, and bevelling off the front of the surface E (Fig. 60). The upper edge of the cap forms the lower lip, the space between it and the edge of the front is the mouth.

Pipes of wood are sometimes made with a languid instead of a block, especially if they are of great size.

Occasionally wooden pipes are constructed with inverted mouths (Fig. 61), in which case the front of the block must project as far as the outer surface of the pipe-front, and the inner surface of the front of the pipe is bevelled instead of the outer. Double-mouthed pipes are sometimes to be found in German organs. They are said to give a greater body of tone, but they have not often been used in this country. A kind of Vox Cœlestis has been constructed on this principle. The mouths are precisely similar to those of the ordinary pipes, but each pipe has two, one in front and the other behind.

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CHAPTER XVIII.

The Reeds.

It has been seen in a previous chapter that pipes were classed into two great divisions, viz., the "flue pipes" and "reeds." Having in the last chapter described the parts of the former, we would now premise of the reeds that it is to them we owe the great richness in the full organ. They have a sonorous and full body of tone that is very useful in almost every combination or kind of music, especially accompaniment. It is the delicate reed that produces the *Vox Humana* effect with such fidelity. Except by means of reeds we could not imitate to a nicety all the old wind instruments, not even omitting the Sackbut itself. The *Bassoon*, the *Oboe*, the *Clarionet*, the *Clarion*, the *Horn*, the *Trombone*, the *Trumpet*, and the *Cornopean* are all not merely names of stops, but, if the pipes are properly voiced, almost identical with the instruments they represent.

It is difficult to determine the exact period at which reeds were first introduced into the organ, but some idea of the antiquity of this form of pipe may be gathered from the fact that they are found in the Chinese mouth-organ or Cheng, the origin of which is lost in antiquity. In Europe, Regals, consisting of very short pipes with metallic reeds, are as old as Charlemagne at least. The German builders were very coarse and rough in their reed work, indeed, it may be confidently stated that however the old builders of the seventeenth and eighteenth centuries excelled in the production of flue-work, they by no means came up to the present condition of things with regard to the reeds. Perhaps the old specimens that we find in the organs of the last century have suffered more than their neighbours of the flue class under the influence of repeated and rough tuning; but the beginning of the present century saw the introduction of a refinement in the making and the voicing of reeds that was new to the builders of that date.

Green did a great deal to further the advancement of reed voicing, and was perhaps the best workman up to his own date in this department.

There are three kinds of reeds in use, two of which are found generally in organs, the third not being often used in this country. The "open reed" gives a greater body of tone to the tube, and is louder than the other varieties. "Closed reeds" admit far less wind, but are more broad in the tongue. This is looked upon as a drawback, inasmuch as dust is frequently lodged under the tongue and prevents the proper speech of the pipe.

The "free reed" differs essentially in the manner in which the sound is produced. It is found very useful for the larger stops on the pedals or great manual. A reed pipe does not depend entirely upon the length of body, or tube, for the tone it produces, but upon the length of the vibrating tongue, which oscillates against the reed and admits a certain amount of wind to the tube. To produce the best quality of tone the vibrations of the tongue on the reed and those of the air within the tube should be equal. The shape of the tube, its width, &c., has something to do with the character and quality of tone produced, but the pitch is entirely determined by the length of the vibrating portion of the tongue.

Reeds are made up of two distinct portions, "the body," or tube, and "the block." The block is made up of "the boot," "the reed," "the tongue," "the wedge," and "the tuning wire."

The boot, B B, Fig. 62, encloses and supports the block, and has also to bear the entire weight of the tube Y, which in the smaller pipes is soldered in, and in the larger ones is supported in a socket fixed to the block. The boot also conveys the wind to the speaking part or reed, and is therefore analogous to the foot of the flue pipes. The block, L L, supports the reed, R R, the latter being firmly fixed into position by a small wooden wedge, W. The reed itself is a hollow tube, slightly conical, the larger end below, and closed. There is a portion of the reed tube cut away, so that its section throughout would appear C shaped, and it is over this cut and against the edges thereof that the tongue T, which is a thin plate of brass, curved slightly outwards, vibrates. The length of the vibrating portion of the tongue is of the utmost importance, and this is regulated to a nicety by the tuning wire, X, which holds the upper portion not required in action firmly to

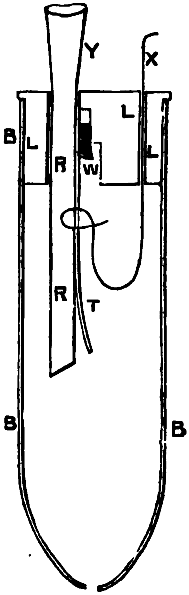

FIG. 62. THE REED.

the reed. This wire passes out of the block upwards, and the end is hooked, so that it may be more easily regulated by the reed knife.

Originally the blocks were made of box-wood, turned, but now they are all manufactured of metal, cast, and worked to the required shape.

In the case of the "free reed" the tongue does not vibrate *against* the edges or on the reed itself, but is allowed to pass between the slit and vibrate by reason of its own elasticity. These reeds are softer and less harsh than the beating reeds, and do away with all the rattling that is frequently so apparent, especially in the lower notes. It has been erroneously stated that a reed vibrates only half as many times to produce a given note as would the air within a flue pipe. The error is due to the fact that the tongue only hits against the reed as it finishes each vibration; in other words, it can only make one audible hit on whichever side the reed may be.

The tubes or bodies of the reeds are formed as are those of the metal flue pipes, any additional bells, &c., being added after the tube itself has been cast and put into shape. It is always advisable to make the narrow and lower end of a reed tube much thicker in proportion to the upper part, for these pipes are liable to bend over by their own weight, and in some cases they have been known to snap off; this latter, perhaps, was owing to the bad composition of the material, probably a too great proportion of antimony, or type-metal.

In practice it has been found that the tone of a reed is made much more smooth if the tongue is allowed to vibrate on leather. Many organ builders prefer to use this in the lower portions of almost all the reed stops, excepting, perhaps, the loudest. The practice is frequently adopted in relation to the lower octave of the *Bassoon*, or even the *Clarionet*, and there is no doubt whatever that there is a great amount of richness added to the quality of the tone. There is a considerable objection, however, to the universal adoption of this practice; the slightest change of temperature, or damp, is apt to pucker the leather under the tongue, and then the pipe has to be attended to by an experienced voicer, to remedy the inevitable mischief that would accrue. In the provinces, therefore, or, in fact, at any distance from the builder, it is advisable to do as much as possible without the addition of leather.

Messrs. Bryceson Bros. and Ellis have lately been constructing some remarkably fine specimens of reeds, which they have placed in the new organ in St. James's Hall. In these the tongues are broad, thick, and play upon wood. The lower notes of this arrangement are of a depth and richness that is quite unusual, and they seem to have got rid of all the rattle and roar usual in very large reeds.

CHAPTER XIX.

Pitch—Nomenclature of the Keys.

The pitch of the flue pipes is determined by their length, as was explained in a previous chapter; but the pitch of reeds depends entirely on the length of tongue. The longer the tongue the lower the note, and *vice versâ.* At first it might appear that the tube of a reed stop could be entirely dispensed with, but the character of the tone is determined by the size, calibre, and length of the tube used. To produce a thoroughly perfect tone, it is necessary that the vibrations of the tongue, and those within the tube, should exactly correspond; it therefore is a matter of extreme delicacy so to tune reeds that this result be brought about. The shape of the tube also has considerable influence on the character of the stop; thus for a loud commanding tone we have a wide tube, as in the Pasaune, whereas the Trumpet, Horn, and Oboe decrease in width. The peculiar nasal speech of the Vox Humana is produced by having the tube half the speaking length of the tongue, but of the full breadth. Thus C-C would have a full length reed, but a tube of only 4ft. in length, of cylindrical shape, like the Clarionet. There are many reeds of delicate tone, as for instance the Cor Anglais, that depend on the shape of the tube for the peculiarities of their speech, the thin tone of the Clarionet is produced by a small scale cylindrical tube. The size and shape of the tongue has of course a good deal to do with the character of tone produced. A thick tongue of brass, and broad in proportion, produces a sonorous tone. A long thin tongue of an alloy of brass and copper gives the delicate tone peculiar to the Oboe, and such soft stops. To sum up the government of reed effect, therefore, *pitch* is determined by size, calibre, and length of reed; *character*, by size, shape, and length of tube.

In speaking of the standard length of organ pipes, it is well to remember that the foot is not taken into consideration, as that portion merely acts as a support and windway, and in no wise affects the pitch.

Pipes assume a variety of sizes, more especially in the flue class, the longest is 32ft., the shortest three-quarters of an inch.

When talking of the length of an organ pipe, reference is always assumed to the length necessary to produce the required sound in theory. There are, however, many influences that bear on the practical sound of a pipe, which cause it to vary slightly from the theoretical length necessary to produce its particular note. Take for instance the note C, this should require in theory a pipe 4ft. in length. If, however, that pipe be subject to a heavy wind, it would blow sharp, and require a longer tube; if, on the other hand, a slight wind be applied a shortened tube would be necessary. The outline of the pipe, its shape, &c., would also have some little influence with regard to length. While on this subject it is perhaps well to mention, that outside or show pipes are almost always made rather longer than is necessary for their tone, and a portion of the back of the tube is cut away or slit to effect the increase of vibration. Therefore the pipes of almost any flue stop can be made to act as show pipes, without disfiguring the appearance of the instrument, or sacrificing the character of the stop used.

The nomenclature of levers on the key-board, or notes on the scale, is a matter of the deepest importance to all those who would master the organ, and in this instrument, more than in any other, is it necessary to define clearly the name of any particular note in the compass. The old English compass and nomenclature differed from the modern or German method not so much in actual range as in the standard notes or starting points. And since we have universally adopted the C, or German notation, it will be unnecessary to minutely go into the obsolete terms relative to the notes on the keyboard. A cursory glance at the old notation will be sufficient to explain those names that we still retain.

Formerly there was a stave of eleven lines, and if, in accordance with our modern fashion, we wrote the compass of that stave, it would stand from the first line in the bass clef to the fifth line in the treble. This was the old gamut.*

As this was extended downwards and upwards, the notes represented by similar letters in different octaves were distinguished by the kind or number of letters used. Thus the double or lower octave was signified by capitals as G G, and the higher octave by A A, or *A*, *a*, *a*, *a*. We retain as landmarks the notes called gamut G and middle C, their positions in our scale being shown in Fig. 63.

Middle C is so called from its position in the old stave of eleven lines, where it appeared on the middle or sixth line. Some notes were named after instruments that commenced their compass with such note, as for instance, tenor C, the lowest note of the viola or tenor violin; fiddle G, lowest note of the violin.

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* The word gamut is derived from the Greek, *γ Gamma*, which represented the first note in the scale; *ut* signifies that it was first, hence Gamma-ut or Gamut.

The following table will give the name of each C that is to be found, with the size of the pipe that produces it; from which it should be clear that with a foundation or 8ft. stop, the actual sounding compass of a five octave keyboard would be from C C to C^4 in altissimo—altissimo being the term used for notes above the modern treble scale:—

		Length of pipe required.	
c c c c	(four c.)	32	feet (largest made.)
c c c	(three c.)	16	„
c c	(double c.)	8	„
c	(tenor c.)	4	„
c1	(middle c)	2	„
c2	(treble c.)	1	„
c3		6	inches.
c4		3	„
c5		1½	„
c6		¾	„ (smallest made.)

C is obviously the proper note from which to commence, as it is the first of the natural scale. All octaves, or more properly septaves, are named as the commencing C of each set, for instance, we should speak of the double or C C octave, tenor, middle, or treble octave. Again, all notes in an octave are also marked and named after the principal of the C which commences the octave. Thus notes immediately following tenor C are marked simply D, E, F, &c.; those after middle C^1 as D^1, E^1, F^1, &c.

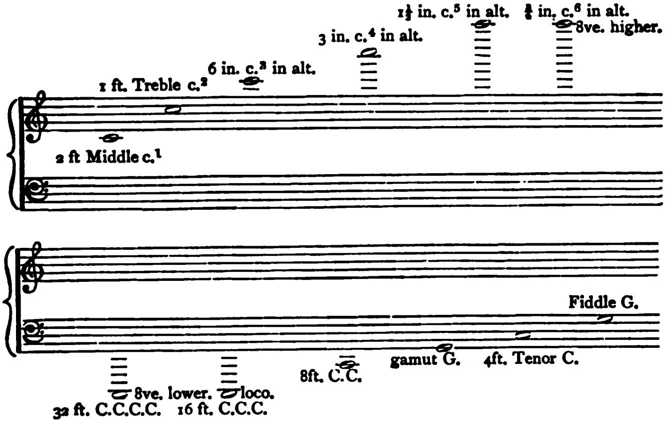

FIG. 63. POSITION OF NOTES ON THE SCALE.

With the above before us we can then name not only any note in the keyboard with accuracy, but also any sound that is produced by either stop either above or below the apparent limit of the keys themselves. If, for example, we speak of the note C it would mean tenor C, produced by an open 4ft. pipe. With a foundation or 8ft. stop we should have the note in its proper position on the keyboard; but there is no key for the note C C C on the manuals, this being the sound produced when pressing the C C key with a 16ft. stop in use. In the same way we can specify a note octaves above the upper limit also. The value of thoroughly mastering this point with regard to organ, or indeed any music, is obvious, when it is remembered that by means of such a notation each musical sound has its own particular name, and can therefore be definitely described, apart from either the musical scale or the keyboard.

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CHAPTER XX.

Scale—Classification of Stops.

ORGAN pipes are not only influenced by their length with regard to the tones they produce, but, more or less, by their breadth also. The breadth of a pipe is called its scale, and when a pipe is made broad in proportion to its length, it is spoken of as having a "full scale," or, if narrow, as being "small in scale;" for instance, the larger Open Diapasons would be of large scale, whereas the Dulciana is a small scale stop.

Scale has not only a great deal to do with the quality of tone produced, but it also affects the length it is necessary to make a pipe for a given note. Thus, if a scale is large, a pipe decreases somewhat in length, and *vice versâ.*

It has been seen that a four-feet pipe, if stopped, produces an eight-feet tone, and these pipes are classed into stops that are said to be of an eight-feet tone, and as a rule, whenever we speak of a stop as an eight, four, or sixteen feet stop, we mean that the pipes produce tones in accordance with such lengths, not necessarily that the pipes themselves are of that length. But that confusion may not arise, it is often found better to say that a stop is of such and such a *tone.* Thus, a Bourdon in a small organ may be mentioned as being of a sixteen-feet tone, when it is understood that pipes are merely eight feet in length, but stopped at the ends.

Different builders are in the habit of making their stops of particular scale, and it is thus that so much character is found in organs, perhaps having identical stops, from the hands of different masters. Again, it is the successful blending of scales that makes up that harmonious whole in the full organ that at once stamps an instrument. It is, therefore, impossible to give figures for the proper scale of any individual stops. Indeed, such a fixed law could not exist. Take, for example, such a stop as a Dulciana. Here we have a delicate soft tone, that is required to be subdued and of gentle quality; put a given scale into a large hall organ, and it answers admirably; put the same scale in another similarly labelled stop, in a small chamber organ, and you have what might almost stand as an Open Diapason, differing slightly in quality, but certainly sufficiently loud.

Taking middle C as a point, the scale of an Open Diapason should range between 6in. and 8in.; that of a Dulciana from 4in. to 5½in.

With regard to the reeds, the size of the tongue has so much to do with the tone produced, that it must be borne in mind that the length of pipe only modifies the tone, and does not alter the pitch. Thus a Clarionet is short, only a little more than half the length of theory; the Trombone taking a much longer tube for a corresponding note.

Stops may be classed into *Whole Stops, Half Stops, Incomplete Stops,* and *Repeating Stops.* It is clearly understood that a stop is a set of pipes that run in order from the one end to the other of the clavier. If this set runs entirely through the keyboard, the stop is said to be a whole, or, technically speaking, a "through" stop. If, on the other hand, it discontinues at any portion of the keyboard, it is said to be a half stop, or if not so much as that, an incomplete stop. Repeating stops are of two classes; those that are made of necessity, as the smaller-sized Mixtures; and those that are so from economy, as, for instance, where a pedal stop repeats its lower notes on an upper octave to save the expense of extra pipes, or, on the other hand, to cover the gap that would be occasioned by an entire absence of pedal.

All the foundation, and a great many, if not all, the stops of a really good organ should be through stops, but it sometimes happens that space or economy has to be studied; and then, in smaller instruments especially, the bass of one stop is made to act for the treble of one or more that should, strictly speaking, be separate. Thus the bass of the Stopped Diapason is very frequently made to do duty as the bass of a Dulciana, or any soft stop. This practice, if not carried too far, may not do much harm, but when overdone it tends to weaken the lower octaves of an instrument considerably.

Half Stops, properly so called, have practically gone out of fashion. The older builders were in the habit of dividing almost all the stops of an organ, and labelling one half treble and the other bass. For instance, you would find "Stop Diapason Treble," and "Stop Diapason Bass." This was useful in giving a greater variety of trebles to a bass, or basses to a treble, but was very misleading, if, when speaking of the number of stops possessed by the instrument, the aggregate number of draw knobs was calculated as the guide. But another kind of *half stop,* which, perhaps, is of a more legitimate character, is where a set of pipes either ceases altogether, or meets another set of a different quality. Snetzler, as well as many other old builders, would make a Cornet in the Treble meet a Sexquialtera in the bass, and these were different stops, inasmuch as the intervals of their composition differed.

Short Stops may be more frequently used with credit than the so-called half-stops, for if, in imitating an instrument, it is found that the limit of such instrument is reached at a given point, it is certainly fair to halt there, more especially so in large organs where a fourth or solo manual exists.

The word stop has been, and is still, rightly used to mean any power of change that an organ may possess, so that those knobs that command coupling movements, Tremulants, &c., are termed "stops." These are classed as accessory stops, but, as a rule, builders are now placing them under the general term "accessory movements."

The so-called size of an organ stop is determined by the lowest note produced by it; thus, if a stop produces the note CCC when the lowest manual key is pressed, it would be termed a 16ft. stop, whereas if the note C were produced, it would be termed a 4ft stop, as it is assumed that the pipe that gives the tone would be 4ft. in length; but it may so happen that it is a stopped pipe that is in question; still, the stop would be called after the size of tone, but the word tone, properly speaking, should not be omitted in speaking of the stop—for example, if a Stopped Diapason is spoken of, it is called an 8ft. stop, because the CC key produces a note that should be produced by a pipe 8ft. long, but we know that in this case the tone is produced by a 4f t. stopped pipe, so we distinguish a closed or Stop Diapason an 8ft. tone stop. In general language, it is fair to say merely that such a stop is 8ft. or 4ft., as the case may be, for it produces the tone of such a length; and that is the great fact of which we must never lose sight. It is very important always to be accurate in this matter, for the casual mention of a stop as of such a length may bring about dire results to one playing, should it not be understood that the tone is alluded to, and the actual length of pipe ignored. It must be remembered that if a stop does not run through, but ends, for instance, on tenor C, it then would be spoken of as a 4ft. or 8ft. stop, in accordance with what the sound would be *if carried down*; thus, a tenor C Oboe is an 8ft. stop, for if continued to CC, the 8ft. tone would be produced on that, its proper key.

Stops are classed according to the kind of work in them, the three principal divisions of flue stops being the *Diapason work*, the *Covered work*, and the *Flute work*. The Diapason work, otherwise called the *Principal work*, includes all those stops that are open, such as the Principal, Fifteenth, Mixtures, &c. The covered work takes in all pipes closed at the top; the Stopped Diapason, therefore, comes under this head, its name notwithstanding. The flute work includes all that would not be classed with the two former, as the half stopped sets, the Flute proper. Gamba, Claribella, Flageolet, and all stops open, but not cylindrical, are among the flute work.

There is another classification of stops, not according to their form, but according to the tones they produce, and here we come upon terms that are most important to master. There are "*Foundation,*" "*Mutation,*" and "*Compound stops.*" Foundation stops are those that give a note corresponding to the key pressed; this does not mean that every foundation stop gives the 8ft. tone on the CC key, but that when the CC key is pressed, some note C is sounded. So that a foundation stop may be of 32ft. or 2ft. in tone size. Thus, if the tenor C key is pressed and C^3 in alt. is the tone produced, the stop would be a foundation stop.

The *Mutation* stops, on the other hand, do not give the sound corresponding to the key pressed, but some harmonic thereof, as, for instance, a fifth or a third. If the former, they are *Quints*; if the latter, they are *Tierces*. They may be of any length, that is, may sound an octave above or below a foundation stop, as the case may be. The early introduction of mutation stops into the organ was touched upon in Chapter I., and their utility is in accordance with some of the most interesting laws of acoustics, of which some explanation will be found in the succeeding chapter. *Compound* stops do not give any one sound to a note, but a combination of two or more; they are of great use, adding brilliancy to the tone of the full organ and reed work, and act again in accordance with the above-mentioned laws.

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CHAPTER XXI.

Mutation Stops—Mixtures.

OF all the attributes of the organ there is none that is of so much importance, or gives to the instrument such character, as the mutation stops. It is to these that we owe the brilliance and brightness of the full organ, as well as the grandeur that has placed this instrument so far above any rival. It will not be surprising, therefore, to find that, in using these compound and mutation sounds, we are following Nature's laws, and not in any way drawing upon art to bring about these effects.

If the bass string of a Violoncello be vibrated, other sounds besides that proper to the string may be detected. These subordinate tones are found to take a particular position with regard to the original or ground tone of the string itself, and they have been termed *harmonics*. In point of fact, harmonics go on in theory to an almost indefinite degree, but there are certain of them that are sufficiently prominent to the ear to become part and parcel of a sound produced by a string. The position of these is fixed and invariable. Supposing, then, the ground tone to be C C, the first natural harmonic would be the octave or the note C, the next in progression would be the fifth above the octave, or the note G, the next would be the octave again, *i.e.*, C^1, the next the third above that, viz., E^1, then would come G^1, and again C^2. It is difficult at first to understand that when the C C string is vibrated all these sounds are produced, but such and a great deal more is the case; for these harmonics not only go on progressing on the same scale, but each harmonic has in reality its own harmonics, so that in theory there is no limit to the number of sounds produced by the one string.

The full explanation of these attendant sounds would require far more space than we can devote thereto; and for their further and minute development we must refer those interested to the text books on harmony. But it is necessary to explain that when a string is vibrated, say, by the bow, it does not move regularly from end to end, and thus set up a given number of oscillations of air to produce one particular sound on our tympana, but splits up into a number of divisions, each of which acts as would a separate string, and vibrates on its own account, in addition to its vibration as part of the whole string. It is to these divisions of the string that we owe the harmonic sounds, and it must be carefully noted that the length of these divisions is always invariable, *i.e.*, in their relationship to the whole string. As only a few of these sounds are actually appreciated by the human ear, it is only such that we have either to provide against, or provide for, as the case may be. The following scale shows all the harmonics it is necessary to notice, others follow in corresponding ratio, but these are the principal. Now, on looking at these notes on the scale, it will be found that the mutation stops of an organ exactly correspond with the position assumed by these sounds. The ground tone being 8ft. C, the first harmonic is represented by the *Principal*, the second by the *Twelfth*, the third by the *Fifteenth*, and the fourth by the *Seventeenth* or *Tierce*, the fifth by the *Octave Twelfth* or *Larigot*, and the last by the *Octave Fifteenth*. All that it is necessary to do, to bring the organ clearly within these laws, is to substitute for the vibrating string a column of air within a pipe, and remember that such column is governed by the same rules with regard to its total vibration and vibrating divisions.

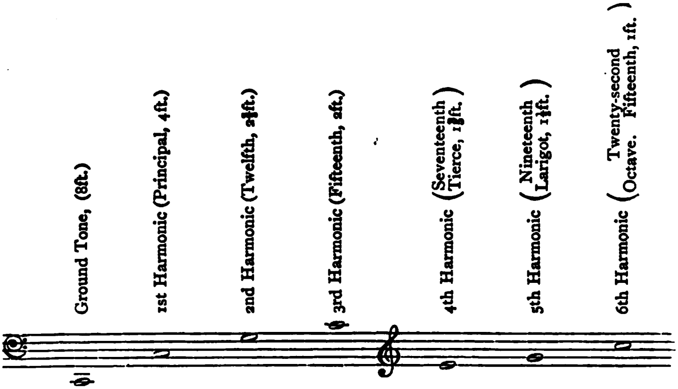
Ground Tone, (8ft.)
1st Harmonic (Principal, 4ft.)
2nd Harmonic (Twelfth, 2⅔ft.)
3rd Harmonic (Fifteenth, 2ft.)
4th Harmonic (Seventeenth Tierce, 1⅗ft.)
5th Harmonic (Nineteenth Larigot, 1⅓ft.)
6th Harmonic (Twenty-second Octave. Fifteenth, 1ft.)

FIG. 64. POSITION OF HARMONICS.

Now, if we were to draw all these stops and produce all these sounds, for every note we used on the Open Diapason, the effect would be simply discord, and utterly unbearable. But it was never intended that artificial harmonics should be so used. Nature has suggested and produced these sounds as subordinate and attendant on their ground-tones. And in using a simple Diapason Stop, Nature has done enough for herself to satisfy our ears. But if, on the other hand, we deepen the tone by adding a 16ft. and many other 8ft. stops, 4ft. tones are wanted to brighten these. And supposing that we have only a number of 8ft. and 16ft. stops in use, we have a heavy and almost dull droning. All the natural harmonics are subdued. The waves they are trying to produce are, as it were, conquered by the ground waves of the principal tones, they have no power of penetration and do not reach us, save in a blurred and confused sound, which adds heaviness to the general effect. But if we assist in adding these tones to our others, the effect is almost magical. Then the natural harmonics are reinforced, they find a strong wave sound of their own calibre, produced by the pipe of their own vibrating length, with which to blend; and they then all come together to the fore, and are able to fill up Nature's proper intervals, and the result is that we have an effect that would be produced by one grand pipe or string of the loudness and calibre of the combined foundation stops. It would be, of course, impossible to get one pipe as loud as a full organ, and by the combination of many to produce such strength of tone the harmonics get mixed. But combine, also, these too, and the then result is beautiful in the extreme—in fact we have a natural sound with its proper attributes.

In small organs it is unusual for these combinations to draw separately under their proper names, and then, as a rule, the *Tierce* and *Larigot* are combined with the *Octave Fifteenth*, to form a *Mixture*; again, the *Fifteenth* and *Octave Fifteenth* are sometimes together as one stop, and are named from the French "*Doublette.*" It will be observed here how very necessary it is to have the length of pipe on the draw-knob as well as the name; for instance, a pedal Quint to 16ft. stop would be twice the length of the manual Quint to the 8ft. stops.

The necessity for these compound mutation stops being established, we must determine the most convenient as well as the most suitable manner in which they can be practically applied. But first as regards their nomenclature. The old Continental "*Sexquialtera*" was a stop containing a *Twelfth* and *Tierce*; this then forming the interval of a sixth, received this appropriate name. Sometimes an extra rank was added, which occupied a middle position, and was in fact a *Fifteenth*, so that on the C C key, the combination would be CC, G, C^1, E^1; occasionally the position of the two original ranks of a *Sexquialtera* was reversed, that is, it was made to consist of a *Tierce* and *Octave Twelfth*, so that then a third being the interval, the stop was named under these circumstances a "Tertian." But a better name for compound stops of this kind is "*Mixture,*" which takes in almost any combination, and at the same time is not confined to any particular number of ranks. It is always well to specify on the draw-knob the kind of *Mixture* it commands, nay, this is absolutely necessary for proper combination; we therefore qualify the term by the prefix "*Full*" or "*Sharp*" as the case may be, always also giving the number of ranks.

To thoroughly appreciate the action and uses of these stops, it is necessary once more clearly to define their object. They are here, then, to corroborate those harmonic sounds that Nature has herself suggested. In making artificial assistants for these sounds, therefore, we have to bear in mind what combinations may be necessary in various positions in the scale to bring about natural results. But a strange anomaly here is noticeable; it is found in practice that, to produce that roundness and completeness that the mixtures should bring about, it is advisable to greatly exceed in strength the sound of some harmonics to the almost total suppression of others, that is to say, if we only enhanced, say, fifth sounds, as apparently nature would have us, we should fail to have the brilliancy we desire, whereas, if we overstep her limits, and have *pronounced* fifths, &c., we produce a result at once satisfactory and beneficial.

A practical difficulty seems to arises at the outset, viz., if we start a *Mixture* on the C C key, having, say, a composition of 19th, 22nd, and 26th, how can the pipes be made sufficiently small to carry out that combination to the top? But, fortunately, it is not necessary to go through the whole scale with the same proportionate relation—such a proceeding would be absolutely against the dictates of Nature; for instance, if the C C key be sounded with an Open Diapason, there are heard the harmonics of the *fifths*, *octaves* and *thirds*, &c., and to corroborate these properly a three rank *mixture* should be used; a passage then is brightened and cleared. If the same three rank *Mixture* be used higher in the scale, say from C^1, then it is over bright in comparison with the bass—that is to say, the bass octave, giving naturally more harmonics, requires more *Mixture* in proportion than the higher octaves, so that while a *fifteenth* and *twelfth* would amply satisfy a treble passage, that in the bass portion requires a three or even four rank *Mixture*; in other words, it is necessary to produce by *Mixtures* only those sounds that Nature wants, and, as she gives us a more complete set of harmonics in the bass, so we require more mutation in that portion of the instrument.

This has brought us to the point of "breaks" in the compound stops. They are required both scientifically and practically, and the only question to be decided, is therefore what breaks should occur, and where they should be placed.

Seeing that at certain points in the scale, higher rank sounds die a natural death, it may be thought that the rank in a *Mixture* representing that sound, should be allowed to die out also, and that the rest of the stop might be continued upwards without the lost harmonic. But in that case the bass portion of an organ would have many more pipes sounding than the treble, and the latter would then be weak in proportion. Therefore, when it is unnecessary or difficult to continue a rank of pipes further, they are brought back an *octave* or a *fifth*, and so the power is balanced. The great rules to be observed in the construction and rearrangement of *Mixture* ranks are, that there be always a preponderance of the foundation tones to the harmonics—that the larger pipes exceed the smaller in number—that there be always more *fifteenths* and *principals* than *twelfths*, *i.e.*, that there be always more *fifteenths* than *nineteenths*, more *principals* than *twelfths*, more *principals* than *fifteenths*.

There is no fixed place as to where these ranks should be broken, but as a rule on modern organs the breaks are made on the C sharp keys. The guide as to what point a rank should return to, whether a *fifth* or an *octave*, must be the rule just laid down. In reference to the necessity of the proper balancing of the foundation and mutation ranks, it will be clear that a *Mixture* of given number of ranks would produce an effect in accordance to its scale and voicing, that it would be filling and round, or keen and sharp according to these conditions.

The *Mixture* most useful, however, is one that will give a brightness to the bass, together with a firmness to the treble without making either disjointed with the other. This is accomplished by a *Full Mixture* of three ranks, 17—19—22 to middle C, after which 12—15—17 are the intervals employed. Mr. Hopkins suggests 15—19—22, and after 8—12—15 as better balance for the treble.

It is usual to make a break return to an *octave* or a *fifth*, and for many years the Continental system was to alternate these intervals. *Thirds* are also used as return points in the treble, but seldom if ever in the bass, for reasons that can be found preceding.

The most useful *Mixture* for a small organ is one of three ranks, and such a stop is to be found in all organs of any pretensions whatever. The fitness of a *Mixture* is easily tested by the experienced ear, but can on paper be at once determined. Suitable balance throughout, with a proper correspondence of tone, is to be aimed at. Such a *Mixture* as that advised by Mr. Hopkins might be added to an organ of six or seven stops; for an instrument of, say, ten or twelve stops it would be necessary to add an extra rank, and it would perhaps be well to introduce a *tierce* into the treble.

Mixtures are seldom or never made of more than four ranks, as it is better—should more mutation ranks be required—to divide them into two or more stops, so that a sharp or full effect may be produced to meet any combination or effect desirable.

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CHAPTER XXII.

Nomenclature of Stops.

The jumble of terms that we have as names to organ stops is very confusing to all the uninitiated, and it is to be lamented that no recognised nomenclature has been devised, by which we should be able at once to define any new stop according to fixed rules. Usually a name is applied by the inventor, in the language of his country, referring to the character of the stop under consideration. It thus comes about that we have on every large organ a mixture of German, French, Italian, and English terms that is most polyglot in character. Some attempt has been made to confine the names of stops to one language, and at St. John's Church, Torquay, all the stops are labelled in Latin, but this involves a knowledge of that tongue that may not come within the scope of many builders, and it is to the builder, often originally to a workman, that we owe many of our best stops, and naturally he first denominates the children of his ingenuity.

In giving a list of all the organ stops now in general use we shall, as far as possible, confine ourselves to the English names, and where two names are found for the same stop, we shall give both, allowing the more suitable preference. Among those of the stops that imitate instruments the name of such instrument has of course remained in whatever language it first occurred.

It will be observed that we first take the flue stops in relation to their size, afterwards the reeds.

*Double Open Diapason** occurs only on large instruments, and is 16ft. on the manuals and 32ft. on the pedals, open pipes, of wood, metal, tin or zinc. When it ceases at tenor C this stop is named the Tenoroon. Instance—Regent's Park organ, manual and pedal.

Sub-bourdon (French) is a rare manual stop of 32ft., tone seldom goes below middle C, never below tenor C, pipes of stopped wood. Instance—Doncaster Parish Church.

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* The word "diapason" is derived from the Greek adverb δια-παντός, and has been used in connection with music for ages. The name is appropriate to this, the principal of all stops. Hawkins, in his "History of Music," seems to infer that diapason originally signified the full organ.

Double Stopped Diapason (on the pedal called *Sub-bourdon*).—Stopped pipes, of 16ft. tone on manual and 32ft. on the pedal. This stop is usually named the *Bourdon*, and is of frequent occurrence on large and moderate organs. It has lately been usual, especially in small instruments, to label a pedal stop *Bourdon*, which is of 16ft. tone, as would be the manual stop of the same name. Instance—St. Michael's, Tenbury, on manual and pedal.

Double Dulciana.—A 16ft. stop on the manual of small scale pipes, not often met with. Instance—Millbrook Parish Church.

Contra Gamba is a 16ft. open metal stop, and usually has a somewhat sharper tone than the Diapason. It is often placed in the swell of large organs. Instance—Albert Hall organ, on great manual.

Pyramidon has been mentioned in some works, but it was found impracticable to make this stop answer throughout the entire scale, and it therefore is abandoned. It was a stop of 16ft. or 32ft. tone.

Open Diapason, the chief stop of the organ, is found in every instrument save the smallest chamber toys. It is a whole stop of 8ft. on the manuals and 16ft. on the pedal organ, open pipes, of tin or metal. In inferior organs the lowest octave is sometimes made of wood, but this is not legitimate. Instances are almost universal. When an instrument has more than one of these stops on the same department, it is usual that they be of different scales, to destroy what is termed the sympathy,[*] the one being of smaller, and consequently weaker tone pipes, whereas the other would be full and round.

Stopped Diapason.—The German name for this stop is *Gedact*; it is 8ft. tone on the manual and 16ft. on the pedal; it occurs in almost every organ made. It was of metal[†] by the older builders, down to tenor C, after which note the pipes were usually of oak or deal. A little while since almost all Stopped Diapasons were of wood throughout, but latterly builders have been substituting metal for wood as far as possible, and this stop is now often of metal.

Dulciana (Latin, *dulcis*) was invented, or, according to some authorities, only introduced, by Snetzler, and, as we have said in a previous chapter, he owed a great part of his success as a builder to the happy reception that this stop received at all hands. It is a soft-toned open stop of

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[*] If two pipes of precisely the same calibre and length, &c., be sounded, they produce only the sound of one. This is called sympathy, and is owing to the fact that they both produce similar wave movements, and therefore the same disturbance of air satisfies the requirements of each and both pipes.

[†] The word metal is not used as a technical term for a definite composition in the above paragraphs.

8ft. on the manual, seldom, if ever, appearing on the pedal. The pipes are of small scale, the quality is exceedingly soft and mellow, and the stop does not speak very quickly. As a rule, the Dulciana does not go further down than tenor C, it then being grooved into the lower octave of the Stopped Diapason, the pipes are of metal. The original Dulciana is still in the organ at King's Lynn, and bears testimony to the delicacy with which the maker voiced his pipes. Instances of this stop are frequent.

Viol-di-Gamba (direct from Italian).—This stop is not to be confounded with the German Gamba. They are of the same class, but have important differences. The Viol-di-Gamba is soft, reedy, and sweet. It is frequently found in the choir department. It is an 8ft. open stop; the pipes are of metal; the shape was originally conical, though now many are made cylindrical. Hill introduced a Gamba with a bell at the top, called it Bell Gamba, and put it into many of his swells. The Viol-di-Gamba seldom goes below tenor C, and is often found grooved like the Dulciana into the bass of the Stopped Diapason. The German Gamba, or Gamba proper, is a stop of louder intonation and somewhat larger scale. The Gamba does not appear on the pedal organ under this name, but a stop corresponding thereto will be found under the title Violone. Instance—Viol-di-Gamba, Southampton Parish Church; Gamba, St. John's Church, South Hackney.

Clarabella (Italian).—This is an incomplete stop, invented by Bishop; it seldom goes below tenor C. It is an 8ft. open wood stop, of large scale, giving a fluty mellow tone. It often meets an octave of bass pipes of the same form as the Stopped Diapason, and in small organs it not unfrequently happens that the Clarabella takes the place of the latter stop altogether. Instance—Romsey Abbey, and it is also frequent elsewhere.

Dolcan (Italian *Dolce*) is an open 8ft. stop on the manuals of bell-shaped pipes, not often met with in England. Instance—Regent's Park organ (under the title of Corno Dolce).

Harmonic-flute (*ante*, p. 135), was the invention of M. Çavaille Colle, of Paris. It is an open flue stop, rarely going below middle C of 8ft. tone; together with this, indeed, as identical, and generally called "Harmonic-Flute," goes a 4ft. stop, of similar form and quality, this reaching, as a rule, to tenor C. These stops are of extreme beauty, the tone being full and fluty to a degree. English organ builders have found this stop, or rather these stops, vast favourites among almost all classes. The pipes are of double length, and they are heavily winded, for reasons explained in a previous chapter.

Hohl Flöte (German hollow-toned flute) is the name given to an 8ft. open stop on the manuals. The tone is not unlike that of a thick

Stopped Diapason. The pipes are made of metal, and are of large scale. Instance—Pro-cathedral, Kensington.

Keraulophon (*κέρας αὐλός φωνέω φώνη*) is a very delicate and beautiful stop of 8ft. open pipes on the manual. It seldom is complete, generally stopping at tenor C, if not grooved into the bass of the Stopped Diapason. It is of a reedy and pleasant quality of tone, of small scale, very delicate in speech, is tuned as a rule by a slide, and has a great tendency to speak its octave. The tone is produced by the appearance of a small hole toward the top of the pipe. This stop was invented by Messrs. Gray and Davison. Instance—R. C. Church, St. Ann, Spitalfields.

Violin Diapason (or Geigen Principal) is a metal stop of 8ft. on the manual. It has a quick speech, and is not unlike the Gamba in tone. One remains in the choir of the Temple organ. It was placed there by Schulze in 1862. Instance—Temple Chapel, Taunton.

Horn Diapason is the name given to a very useful stop of 8ft.; this also is of metal. It has a peculiarly reedy intonation. The rasping of the bow is also heard to some extent. Instance—Leigh Church, Essex.

Salicional, or Salicet (Latin, salicetum), is a small scale metal stop on the manuals. It is of reedy and quiet character; more often this stop occurs on the choir or swell department. Instance—St. Paul's Cathedral, and frequent.

Voix Celeste is a stop that has been introduced of late years by the French. It consists of two ranks of metal pipes of 8ft., usually two Dulcianas or Gambas. These are at first tuned in unison, and then one of the ranks is slightly raised in pitch. The effect of the stop is very pleasing as a change, though it is sometimes too much used by inexperienced performers. The Germans have a stop of this character called *Unda Maris*, which is sometimes described as identical with the Voix Celeste; but, as a rule, the former is of louder pipes, and the second rank is tuned sharper, so that the waves caused by their inequality of pitch are more marked. The first Voix Celeste introduced into England was put into the Panopticon organ, now in the Clifton Rooms. Instance of Voix Celeste—Pro Cathedral, R. C., Kensington; Unda Maris—Town Hall, Manchester.

Quint, or "Fifth," is the largest mutation stop of the organ. It acts to these stops as would the Twelfth to the 4ft. stops. It is of open pipes, sounding just a fifth above the ground tone. It is, therefore, of 5⅓ft. on the manual, or 10⅔ft. on the pedal. Sometimes the Quint has been made of stopped pipes, but this is not usual. Instance—Manual and pedal, Albert Hall.

Principal or Octave.—This stop is the one of most importance among the 4ft. stops. It is almost always of metal open pipes, and sounding an octave above the Open Diapason it has come to be called simply "Octave." It is very usual to "lay the bearings" on this stop, and then tune all others from it. In organs of any pretensions there is always at least one Principal to each department, that of the pedals being of 8ft. Sometimes it has been that two Principals are on the same manual; this is usually the case when there are more than one Diapason, or many 8ft. stops. Under such circumstances each stop would have its scale regulated in accordance to one of the Diapasons. Instances of this stop are universal.

Dulcet is the name given to a stop resembling the foregoing, but made of Dulciana pipes. It is extremely delicate and is useful for the choir or swell departments. Instance—Rochester Cathedral.

Flute.—Under this heading 4ft. stops of many kinds are labelled, all more or less resembling some kind of flute; but the older builders were in the habit of constructing a 4ft. stop of metal, spoken of in a previous chapter, which was usually named "Flute"; then the so-called flutes were made of wood, but of late years it has been the custom to more accurately define the stop by some prefix, such as Walde, Swabe, &c., and inasmuch as these stops are each of distinctive character, we shall take them in order. There is a pedal Flute that is now much used, and is extremely useful—it is usually a wood stop of 8ft. tone.

Spitz-flöte (German spire flute), is a stop of 8ft., 4ft., or 2ft. in Germany, but as a rule is of 4ft. in this country. It is slightly conical in form, and is of open metal pipes; the tone is soft but very satisfying. Instance—Regent's Park organ.

Walde-flöte (German forest flute), is a stop of 4ft. open pipes. Usually in this country it is of wood, but in Germany many are made of tin or metal. The tone is extremely clear and piercing, the mouth is inverted; it seldom goes below tenor C. The late Mr. Hill introduced the stop into many of his organs. Instance—Trinity Church, Taunton.

Swabe-flöte, (Latin *suavis*). This stop resembles the last in almost every particular, but is not quite so loud in tone; it also was introduced by Hill. Instance—Parish Church, Great Yarmouth, and generally frequent.

Clear flute resembles the Walde-flöte in tone, but differs in the construction of the block. Messrs. Kirtland and Jardine, of Manchester, invented the stop, and it therefore is to be seen in many of their organs.

Flauto traverso should really represent the instrument used in orchestras, inasmuch as the word traverso merely distinguished that instrument from the flute, which was played direct from the end, as are the present whistle toys; but it has come to mean in organ work a 4ft. flute of sweet intonation, not so sharp in tone as the Walde-flöte. It is to be found in many organs, but the name is not satisfactory, for the

Orchestral Flute and the Block Flute are the stops that really represent the instrument in question. Instance—Ripon Cathedral.

Oboe Flute.—This stop is far more delicate and reedy in tone than the preceding. It is of wood, of 4ft. tone, and is not unlike the Viol di Gamba, only softer. Instance—St. Luke's Church, Manchester.

*Rohr Flöte** (German reed flute), is the name given to an 8ft. wood stop of the half-stopped variety. It is in reality a Stopped Diapason with a small tube or reed sticking through the stopper, hence its name. The French *Flute à Cheminée* is another term for the same stop. Instances—Rohr Flöte, Trinity Church, Hull; Flute à Cheminée, Albert Hall.

Orchestral Flute, as its name signifies, is made to represent the instrument used in the orchestra. It usually appears on the solo department of our larger organs. It is very effective as a solo stop, and is usually, if not always, of open metal pipes. Instance—St. Paul's Cathedral.

Flute à Pavillon (French Bell Flute) is the name given by the French to a 4ft. metal stop, having bell-shaped pipes. The stop is not often made by English builders. Instance—Albert Hall.

Gemshorn (German goat's horn) is a 4ft. stop of metal, mentioned in previous chapters as being one of the conical stops. It is usual now to make little, if any, difference in the diameter of the pipes throughout. One remains of Smith's make in the swell of the organ at Tiverton. This is conical. It is a useful stop, of softer tone than the principal. Instance—Temple Church, and frequent.

Celestina is the name given to a 4ft. stop of soft intonation. It is by no means common. Instance—Christ's Hospital.

Nason was a stop that the old builders frequently put into their organs. It was of wood, stopped pipes, 4ft. One remains in the Temple organ.

Viol d'amour is an extremely delicate stop of 8ft. on the manuals. It is of open metal pipes of small scale; the tone is somewhat between that of the *Keraulophon* and the *Dulciana.* The *Viol d'amour* was a stringed instrument, so that one would almost have thought its counterpart should have been a reed; but it is a useful stop as it stands, and is usually, if not always, on the choir department. Instance—St. Peter's, Tiverton.

Doppelflöte (German double flute) is a stop consisting of pipes having two mouths. The shape is square, and the material, of course, wood; the block is bevelled off to form the two under lips. These mouths are on the same level, and the tone is full and pleasing. In some cases one of the mouths was slightly elevated, and the stop was then called the *Biffara;* the difference in position of the mouths caused an undulation of sound such as is found in the *Unda Maris.*

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* This stop is also sometimes called Rohr Gedact.

Clarionet Flute is a stop of 8ft. tone, almost identical in structure to the Stopped Diapason, but the stopper is perforated; the tone is pleasing and very reedy; it is occasionally of 4ft. tone. Instance—The Oratory, Brompton.

Tenth.—This is the *Double Tierce*, the largest of the mutation stops sounding the third; it is seldom to be found except in the largest organs. It is of 6⅖ft. on the pedal and 3⅕ft. on the manual. Instance, pedal and manual—Doncaster Parish Church.

Twelfth, or *Octave Quint*, is an open metal stop of 2⅔ft. on the manual and 5⅓ft. on the pedal. It is more frequently found than the tenth; it is a fifth above the Principal, and therefore a twelfth above the diapasons. Instance—Chelmsford Parish Church.

Fifteenth is an extremely useful stop; it is of open metal pipes, and sounds a fifteenth (*i.e.*, two octaves) above the Diapasons. It is of 2ft. on the manuals, 4ft. on the pedals; there are few organs without this stop.

Block Flute is a 2ft. stop, much like the *Fifteenth*, only of larger scale. Father Smith was very fond of this stop, and introduced it into the majority of his organs; one of his construction remained in the organ of St. Paul's Cathedral up to a recent date, and was labelled "*Large Fifteenth.*"

Piccolo (Italian) represents the instrument after which it is named; it is often of wood pipes, 2ft., open; it is very useful, as it brightens a passage, and is more fluty in tone and less sharp than the *Fifteenth.* Instance—St. John's Church, South Hackney.

Flageolet (French—Flagelet).—Almost like the preceding but not quite so shrill, being of smaller scale. Instance—Manchester Cathedral.

Harmonic Piccolo is a stop of 2ft. tone, having pipes of double length, made after the fashion of the Harmonic Flute, before described. Instance—Sandford, Dorset.

Octave Fifteenth sounds a twenty-second above the Diapasons, and is the highest foundation tone ever carried through an organ; it is of open metal pipe, of 1ft. tone; it seldom occurs as a separate stop, generally forming one of the ranks of a Mixture. By referring to the specification of the York organ, page 15, Part I., it will be seen that it is mentioned therein as a separate stop.

Tierce (French) is of open metal pipes, and sounds a third above the Fifteenth—it therefore is a seventeenth—like the Octave Fifteenth, it usually forms one of the Ranks of a compound stop.

Larigot (French), or Octave Twelfth, is a nineteenth above the Diapasons, and occurs more often as an important rank of the Sexquialtera than as a separate stop. Instance—St. Sepulchre's.

Doublette (French) is the name given to a stop consisting of two ranks of pipes, sounding the one a *Fifteenth* and the other a *Twenty-second.* It is not often to be found on modern organs. Instance—Parish Church, Southampton.

Before going on to describe the compound stops, it is not out of place to say a little as to those that have already been mentioned.

In the first place, with regard to stops of 8ft. tone. It has been seen that the naming of stops is so purely a matter of individual caprice that it will not be suprising to find that there is a host of stops remaining that have been left out of the above list, merely because they so minutely resemble some one of those already mentioned that their individual characteristic is hardly of sufficient moment to warrant a further description. Then, again, there are some stops so rarely met with that to enter into a particular account of them would be but waste of time to all save enthusiasts. Among these we may mention the *Terpodian, Jubal Flute,* &c. The same may be said of the stops of 4ft. tone, with this distinction, that the majority of the flutes fall under this head. It would take a really long list to give every variety of flute, or every name under which the same flute has gone. The Germans are specially rich, at least in names, for we find such instances as *Bauerflöte, Scharfflöte, Spillflöte,* &c., continually cropping up.

COMPOUND STOPS.

A pure *Sexquialtera* (Latin) is seldom met with. It would consist of a *Twelfth* and a *Tierce,* these together forming the interval of the sixth; but the name has come to mean a compound stop, having sometimes as many as five ranks.

A five rank *Sexquialtera* would have the following intervals from the unison: 17th, 19th, 22nd, 26th, 29th; a four rank would be 15th, 17th, 19th, and 22nd; a three rank would be 17th, 19th, and 22nd. This, it must be remembered, would not always be the case. The mixture ranks are always adjusted according to circumstances, explained in a previous chapter. Thus, for instance, if a Tierce drew separately, it would not, as a rule, be advisable to have a tierce rank also in the compound stop. It will likewise be remembered that there occur breaks in these compound stops, usually at the middle C^1; then the position of ranks would be altered according to the requirements of the treble as to mutation, as explained in a former chapter.

Instances of the *Sexquialtera* are very frequent, especially in old organs, but we have come across only one genuine two-ranked stop of this name in an English organ by an English maker, and that still remains in the organ at St. Mary's Church, Taunton, and even here it is labelled "*mixture.*"

Mixture.—This is a far better name for compound stops than any other, for the simple reason that it cannot be incorrect; and it is presumed that any organist who values his reputation would master the exact formation of every mixture before using it. These stops are of from two to five ranks; they are made of many different compositions. We, therefore, merely give a general specimen of what a Mixture might be expected to contain. When of five ranks it is much the same, if not identical, with Sexquialtera of same number.

A very useful clear mixture of four ranks is given by Mr. Hopkins, as follows:

CC to fiddle G	19	22	26	29
Fiddle G sharp to middle C^1	15	19	22	26
Middle C^1 to treble C^2	12	15	19	22
Thence to top	1	8	12	15

An extremely useful three rank mixture is made up of the following:

CC to middle C^1	15	19	22
Middle C^1 sharp to top	8	12	15

A two rank mixture usually consists of

CC to Middle C^1	26	29
Middle C^1 sharp to top	19	22

There are many more compositions just as useful under certain conditions as the above, but we must refer our readers to larger works, where the whole question of Mixtures and their relations, compositions, &c., has been fully discussed.

Furniture (French—Fourniture) is an old stop seldom found on modern organs. It was a compound stop of from two to five ranks, and was usually of smaller pipes than the Sexquialtera or Mixtures. Instances are given by Mr. Hopkins of a *Furniture* having intervals of a 32nd and 36th above the unison. There are of necessity breaks at every octave on account of the smallness of the pipes. Instance—Albert Hall organ.

Cornet (French).—This name at first would strike the uninitiated as belonging to a reed stop of some kind. It has done duty for various kinds of stops, but more especially for a curious compound stop that has now become obsolete.

For some reasons, probably to give the tone prominence, this stop was put upon a soundboard of its own, *above* the other work; it thus derived the title "*Mounted Cornet.*" The composition was curious; it consisted of an *Open* or *Stopped Diapason*, *Principal*, *Twelfth*, *Fifteenth*, and *Tierce*; it was used to "give out" the melody of a hymn, &c., and the effect was by no means displeasing. The old builders often gave the title *Cornet* to the treble portion of their compound stop, labelling the bass, which was of a different composition, *Sexquialtera;* this was the case in many instances, especially among the English. The Germans used to carry the Cornet as low as tenor C, the English rarely below middle C, so that a builder might label the bass of his compound work *Sexquialtera,* and from middle C label it *Cornet.* Snetzler adopted this plan in the little organ of St. Decumans, and in many of his larger works.

There is a compound stop of various intervals, much, in fact, like a mixture, called the "Echo Cornet;" this is made of pipes to *Dulciana* scale; the consequence is a softness that is often of great value. This stop is frequently placed in the Swell to further subdue the sound. Instance—Public Hall, Glasgow.

THE REED STOPS.

Contra Bombarde.—This is the largest reed made. It is of 32ft. tone, and is always placed on the pedal department. It is very powerful and sonorous, and is especially adapted for giving strength and depth to the slower bass passages. The tubes are frequently of zinc, and sometimes a set of pipes an octave higher than the stop itself is placed close to the pipes proper, that they may be less sluggish in their speech. The stop is not common. A good instance occurs in the Regent's Park organ.

Bombarde (French) is the largest reed of the manuals, but is frequently found in the pedal department. It is louder and more prominent than any other manual reed, and, like the Contra Bombarde, adds grandeur to the slower passages. It is of 16ft. length, the tubes being frequently of wood. Instance—Pro Cathedral, Kensington.

Double Trumpet is a manual stop of 16ft. It is, like the Bombarde, often made of wood. It is of the same character of tone as the Trumpet, but, as a rule, is voiced more softly. When this stop is curtailed at tenor C it is called Tenoroon Trumpet. Instance—Salisbury Cathedral.

Double Bassoon, or Contra Fagotto, is the stop answering to the Clarionet of 16ft. length. It is of smaller scale and less sonorous than either of the preceding, and is very useful in adding a depth and richness to the full passages of a manual organ. This stop is frequently found in the Swell department, and the lower octave of pipes is sometimes mitred to meet the requirements of its position. Instance—Pro Cathedral Kensington.

Double Oboe is an extremely rare stop, only met with in the largest instruments. It is of 16ft. length, and is made of a scale proportionate to the Oboe, that is, rather small. It is rich and soft in tone, and would be a very useful stop in many organs in lieu of some of the louder reeds that are more frequently to be found. Instance—Albert Hall organ.

Posaune (German), or Trombone, is a stop of 8ft. on the manual, and is one of the most full toned of the reeds. It answers to the English Trombone, and is made to represent that instrument as much as possible. It is of large scale, and is not unlike a loud Trumpet in tone. Instance—Trinity Church, Taunton.

Trumpet is an 8ft. stop, found on the manuals. The tone is somewhat less harsh than the Posaune, but more prompt and self-asserting than the Oboe; it is of good scale, and is made to imitate the instrument of the same name. The tubes are of metal, and have no bell. This stop is often found on the great manual of small organs, and it is very useful for triumphal effects in marches, &c. Occasionally it is used in solo work, especially when there is no fourth manual with heavily winded reeds. Instances—Universal.

Horn is a fine full toned 8ft. manual stop, of large scale. It has not the clang of the Trumpet, and is of rounder tone. It is often found in the swell department, but is not always made of so large a scale as it should be. The Horn is said to have been invented by Bridge. Instances—Frequent.

Cornopean is again an 8ft. manual stop, standing between the Horn and Trumpet with regard to tone, &c. It is rounder and more smooth than the latter, at the same time being scarcely so loud as the Horn.

Oboe or Hautbuoy (Italian—Oboe; French—Hautbois), is a very beautiful 8ft. reed stop, formed chiefly on the Swell manual; the tubes are of metal, and have belled tops. The character of tone is soft and mellow, and is made, as far as possible, to represent the orchestral instrument after which the stop is named. No reed on the organ is more useful in general work, as the Oboe can be introduced to lend richness to an accompaniment, as well as to add depth to a voluntary. There are few organs that do not possess a specimen of this stop on the Swell, and it is, perhaps, the most popular of all reed stops. Instances—Universal.

Bassoon (French) is spoken of as a separate stop, though it forms as a rule a bass octave for the Clarionet; it is of 8ft. length and is of small scale, having pipes to correspond with the last mentioned stop. There is a richness about this stop that is particularly fine, and it seems a pity that any organ should, having a Clarionet, lack this important octave of pipes. Instance—Trinity Church, Taunton.

Clarionet, or Cremona, Cremorne, &c., is an 8ft. stop, made to represent the orchestral instrument of this name. It was called in the German nomenclature "Krum-horn" (crooked horn), and has thus sometimes been roughly Anglicised into "Cremorne," and then, probably by a mistaken notion that it was intended to imitate the violin, it was called "Cremona."

The stop itself is one of the most perfect of our imitations. It is of small scale pipes, and, inasmuch as the orchestral clarionet is of limited scale, the stop seldom goes below tenor C, another octave of pipes being drawn to complete the manual compass, under the name "Bassoon," as mentioned above. The Clarionet is a great favourite among English builders, and it is often found in moderately small organs, where it forms an important solo stop. On instruments of three manuals it is usually, if not always, placed on the Choir. Instances frequent—One of great beauty at Ripon Cathedral.

Tuba Mirabilis, or Ophicleide, is a solo stop of immense penetration and great power, to be found only on large instruments of four manuals. It is of 8ft. length, and is usually on a wind of from 10in. to 15in. It is used to "give out" marked passages, and has a very grand and imposing effect. Sometimes, as at the Crystal Palace, the pipes are placed so that they form a fanlike arrangement with the mouths outward from the organ-that the tone may be more prominent. Instance—St. Michael's, Tenbury.

Orchestral Oboe deserves mention as a special stop, as it is made of more delicate tone, and more to imitate the actual instrument than the ordinary Oboe. It occurs on the fourth manual of large organs, is of small scale pipes, 8ft. tone, and has a kind of mushroom-like cap at the top. Instance—Wells Cathedral.

Cor Anglais is a very unusual stop, but is nevertheless of considerable value. The shape of the pipe is peculiar, as will be seen from the accompanying cut. The tone is particularly soft and mellow, of 8ft. calibre. The Cor Anglais is sometimes a "free reed." Instance—Regent's Park organ.

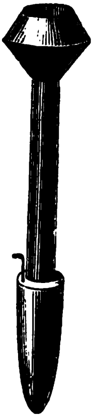
FIG. 65.
COR ANGLAIS.

Vox Humana is, perhaps, one of the most beautiful stops among the reeds. As its name would indicate, it is made to represent, as far as possible, the tone of the human voice. The tubes are of half length, *i.e.*, the stop being of 8ft. tone; the tubes are only about half their proper length, but the tongues of the reeds make the 8ft. vibration. The great fault of the stop is that it so often is of a squeaky quality, resembling the tones accorded to Punch, but when well and carefully voiced, and used in conjunction with the Tremulant, the stop is extremely beautiful. It is greatly improved by being enclosed in a separate swell box *within* the usual Swell of the organ, for the rough squeak is then subdued, and the curious voice-like effect is more marked. The stop is very delicate, and requires the frequent attention of the tuner. Instance—R. C. Carmelite Church, Kensington.

Clarion is a loud-voiced reed of 4ft. length. It is found in the larger instruments usually in the swell, and is meant to give brightness to the full organ. It is very useful for this end, and is therefore often to be found in comparatively small instruments. Instance—St. John (of Jerusalem), South Hackney.

Octave Clarion is the smallest reed stop made. It is of 2ft. length and, in point of fact, merely carries on the clarion. It is found on the largest organs only, and breaks first into a Clarion and eventually into a Trumpet, on account of the small size of the pipes as the stop ascends. Instance—Crystal Palace large organ.

There are a few stops in the reed department that are scarcely worthy of separate consideration; not that they are in themselves of no value, but because they are rare, and without special merit.

The *Contra Posaune*, a 16ft. manual or 32ft. pedal stop, almost identical with the Bombarde. Instance—On manual and pedal, St. Paul's Cathedral.

The *Corno-di-Bassetto* has sometimes been looked upon as a separate stop, but it really is another name for the Clarionet. Instance—The Parish Church, Tiverton.

The *Corno Flute* is a soft 8ft. manual reed, with no especial feature.

There will be found many names for stops not mentioned in the foregoing chapters, but they must all be of the character of one or other of those described. The capricious manner in which some builders have altered the titles of the most ordinary stops puts a complete list of names out of the question in any work that does not pretend to be exhaustive.

CHAPTER XXIII.

The Combination of Stops.

In order to play the organ with any degree of power it is absolutely necessary to have a knowledge of the quality and tone of the individual stops, together with their more usual combinations. In the last chapter was given a general epitome of the stops, and it cannot be too fully explained that the effect produced by a performer depends almost entirely on the amount of knowledge and experience he may bring to bear in combining these judiciously, so as to produce the results he may require and a suitable amount of light or shade in the music he renders. The old adage, "Knowledge is power," is nowhere more forcibly exemplified than in the playing of the organ. The best organ built is a mere conglomeration of pipes and noises, in the hands of an ignerant player, and by ignorant we mean one who does not understand the conditions desirable for the exposition of the stops, individually and in combination. The organ, more than any other instrument, has an individuality, and each one has its particular beauties, not altogether depending upon the stops it contains, but more nearly relying upon their combining capacity, so that in one organ a certain combination may produce an effect differing materially from the same named stops played together on another. For instance, we have known a first-rate three-manual organ where the combination, Gamba, and Hohl-flute was almost always used in preference to the usual Open and Stopped Diapasons. But there are, nevertheless, given fixed rules that always apply up to a certain point in all instruments. In using Mutation and Compound stops it is always essential that the ground tone has prominence, and further, it does not do to permit too great a distance between a Foundation and a Mutation sound, when used together. A 16ft. tone will not coalesce or be brightened by a Twelfth or a Tierce, but should be assisted by the Quint proper. The rule is, then, that the rank of Foundation tone next in size to the Mutation should always be drawn "to cover" the harmonic sound. It is hardly necessary to point out that the Compound stops are in themselves useless except combined with Foundation stops, and unless properly blended they had almost be better absent. The complete organ tone should be distinct, full, and bright, and the Foundation tones give the first, the Mutation the second, and the Compound the third of these qualifications.

In using or combining the Foundation stops, the quality of tone of the individual stop has to be considered, for, as we said in a previous chapter, a stop may be voiced either loud or soft, and almost all voicers give to the tone some character that is peculiar to their own manipulation.

The Open Diapason is perhaps the bread and cheese of the organ. It is full, grand, solemn, and sonorous, admirably suitable for sustained harmony and slow movement. By adding the Stopped Diapason a certain amount of body is imparted to the tone, without altering the character in any marked degree. The Dulciana also gives a filling effect, if added, but it is never advisable to add a flue stop of reedy character, such, for instance, as the Keraulophon, as the quality of the stops has a tendency to clash rather than combine.

The Stopped Diapason is very generally looked upon as merely a filler in for other work, and is used only in conjunction with the Open Diapason to give body, or with some other stop to impart character. It is, nevertheless, a great mistake to imagine that the Stopped Diapason should be only so used. In four-part harmony it is very beautiful for short soft passages, and serves as a contrast to a reedy stop that may have been used before. It also serves to accompany soft choral passages. As a solo stop a good specimen is especially beautiful; it is soft, mellow, round, and fluty, and alone or in combination, may often thus be brought on with great advantage. This stop blends very beautifully with the Clarionet, as also with the swell Oboe; indeed, some organists seldom draw these latter without a Stopped Diapason to give them colour.

The Dulciana is, perhaps, one of the most useful of soft stops—it has a curious half plaintive singing tone, and in soft harmony, or even occasionally in solo, is of great use to the organist.

The Gamba is a stop with a stringy tone, and is very useful for taking harmonies that are suitable for string work. It blends well with the Hohl-flute or Stopped Diapason.

The Claribella should be noticed as a good solo stop, especially for passages soft, but of a somewhat marked character.

The experience of every organist will teach him to change his stops judiciously during a continued performance. Even small organs are capable of rendering changes that are most satisfactory to the ear. After having used a reedy stop, such as a Keraulophon or a Gamba, for the accompaniment of a verse in a psalm, to use a Stopped Diapason or a good Flüte is extremely marked and beautiful.

The Clarionet is too often used only for solo, or in strong combination, but if it is a good specimen it is well adapted, especially if combined with a Stopped Diapason, to part playing, and, if after using these resort is had to Flutes of eight and four feet on the Choir manual, one of the most satisfactory changes is produced. The Trumpet makes a fine bold solo stop, though it has not very frequently been put to this purpose. It gives out a psalm or hymn in large buildings, and for large choirs, with remarkable effect. It is well to combine this stop with both the Diapasons, for they, without taking its individuality, will round off its rather piercing effect.

The Oboe is, perhaps, the most useful of all reeds ; it combines well in the Swell for accompaniment. If of good quality it affords a fair accompaniment by itself, especially for flue stops. In this way it can be made to do duty for the Vox Humana in some of the music of the modern French School, and it may even be enlisted as a solo stop occasionally ; indeed, in octaves and with the Tremulant it is very effective for plaintive and wailing solo work.

In regard to marking the *pianos*, *crescendos* and *fortes* on organs, allowance must always be carefully made for the instrument in use at the time. So much, indeed, is this the case that, except in rare instances and with the most usual stops, we do not think it is a judicious practice to mark the stops to be used at different points of a composition. Under any circumstances a *pp* passage should be rendered by some very soft stop, such as a Dulciana or Stopped Diapason on the Swell; for *p* draw Stopped Diapason and perhaps some other 8ft. stops of soft character ; *mp* would require an Open Diapason, combined with any stop or stops suitable to the music under consideration; for *mf* draw Principals, and all stops up thereto, and perhaps a soft reed ; *f* would require all the flue stops up to and including the Twelfth, and if the organ be large, might include some of the reeds of 8ft. or 16ft.; for *ff* the Great Reeds would be drawn, and of course the Mixture work.

The foregoing would apply to a moderate organ, of say thirty stops, and three Manuals. But the rules cannot be laid down exactly, as they differ in almost every instrument. In large organs, if not in smaller also, it would certainly be advisable to add one or two Mixtures to produce an *f* effect; but the addition, as also the number of ranks, must depend entirely on the size and amount of flue work already in use.

The Pedal Organ must be regulated in accordance with the Manuals, and should always be made to render a bass corresponding to them, but in large organs containing reeds of 32ft these are only added in slow grand passages that will admit their proper speech, and, as a rule, are used principally for final "*grandioso.*"

A word must be said with regard to the addition of 16ft. flue stops to the manuals. These are now becoming general in modern organs. For many years they have been in use in Germany. The reason that the organs of Smith, Harris, &c., appear (according to the specifications) so noisy and so over-weighted with Mutation and Mixture, is simply because these builders were reckoning on the introduction of doubles that were excluded either on account of funds, prejudice, or room. The Germans owe their style of music to the presence of these weight-giving solemn stops, and there appears every reason to believe that Bach always drew the doubles when he executed his fugues. There is now no manner of doubt that every organ should have doubles on the manuals, though this does not mean that music is to be rendered heavy and over ponderous by their injudicious prominence.

It is out of the question to give a tithe of the very many combinations that a good organ will allow. Every player will find out, by careful study and attention, that their name is legion. On the other hand, there are, we think, a few suggestions that will bring out many effects, that seem, until very lately, to have remained dormant in many moderate organs. How few organs are there that do not possess a Stopped Diapason and a Fifteenth, on one and the same manual, and, perhaps, for an occasional solo passage, to brighten a phrase in a hymn, for instance, there are few more striking effects. Then, again, the combination of a 16ft., an 8ft., and a 4ft. flue stop, all of the Flute work, give an excellent effect for a solo. We have known the Stopped Diapason, Fifteenth, and Twelfth, used in the higher octaves for a *staccato* solo passage with great success, the effect being bell-like. Combinations suggest themselves at every turn, and every organist will be taught, and learn from experience, more than can be instilled by mere reading. But we cannot leave the subject without saying how often fair executants and men of taste will play for years on an organ, and, having got into a groove and a hum-drum style, fail to utilise some of the most beautiful combinations under their immediate command.

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CHAPTER XXIV.

Temperament.

It is not easy for moderns, whose ears and fingers have been accustomed to our present scale, to understand the difficulty that stood in the way of free composition by the early writers. Running from key to key, enharmonic changes, and the indifference, so far as the actual scale is concerned, of the key a passage may be in, are all comparatively of yesterday. The advantages of our modern system of tuning and the temperament that is now almost universally adopted, are so manifest, that it seems difficult to realise the great battles that were fought as each step forced itself into being. But the war is only just over, and even now we know of fine organs that are tuned in accordance with the old rules and according to the unequal temperament, of the advantages and drawbacks of which our readers will presently be able to judge for themselves.

When, or by what individual, the sounds between the octaves were first treated with definite recognisance and division is hardly known, and although the scientific divisions of an octave must always have been invariable, it nevertheless might have happened that the fanciful or arbitrary division that man chooses to call a *musical* scale, might have turned out a very different affair to the arrangement we now recognise. Nay, the study of the scale used by the native tribes of India and other eastern nations is full of intense interest on this point.

From time immemorial the sounds between the octaves have been divided into fifty-three divisions, called *commas*. Now these commas are the scientific possible divisions of the sounds between octaves. The first thing that strikes a modern student is, that it is impossible to divide the twelve semitones that we possess into equal proportions, for fifty-three will in no way bear equal unfractional division. Then we must remember that the old musical scale was *Diatonic*, without the extra semitones, and that it consisted of what we have termed a natural diatonic scale from octave to octave. Here it is that this queer idea will creep in about the positions of these divisions which *we* have been taught to look upon as natural; *we* say, that to have a natural scale, the semitones must appear as the intervals between the third and fourth note and the seventh and the eighth; all the others being tones. Then we say we have the natural gamut. But supposing that our ears had always heard and been taught some widely different arrangement, *minor* as we might now call it, such as a native Persian says is *his* natural gamut. It is probable that there is yet a most interesting work to be written on this subject by some thoroughly competent authority who has travelled and heard and learned more "*natural gamuts*" than perhaps we wot of.

But in our own old scale there is no doubt that they first had what we must look upon as the gamut proper, that is, they rose from the key note in tones and semitones till they arrived at the octave above.

The sizes of these tones differ, and their relative distances from each other are not identical. The annexed scale will give the accurate divisions of a purely musical scale, from one octave to the other. A glance at this division will show that all harmonious blending and changing would be extremely difficult, and that any attempt at Harmony must be confined to one key. Indeed, there was only one available scale. But if we remember the limited use to which the organ was originally put; that progressions were only made from one note to another; that there were altogether only at most two octaves of notes; that the instrument was only used as a guide for voices; and that single notes only were sounded; we see at once that this scale was up to the requirements of the age.

In the course of time the extra *semitones* were introduced, perhaps to further the possibility of transposition, and as the advisability of transposing to a higher or lower key became recognised, to suit any particular voices, so it became clear that with this scale such transposition was out of the question; for any relative change of position in these tones would bring the wrong number of commas between such tones.

To illustrate this more clearly, if it were desirable to transpose a tune a fifth, then the first interval would appear as a minor tone of eight commas, as between G and A, whereas the first interval of the scale should be a major tone of nine commas as between C and D, its legitimate position.

It was soon discovered that some of the tones in the scale might be tuned slightly flat or sharp in relation to the others, without seriously offending the ear, and this led to the system of

1. Major tone. 2. Minor tone. 3. Semitone. 4. Major tone. 5. Minor tone. 6. Major tone. 7. Semitone. 8. (Octave).

0 + 9 commas = 9 + 8 commas = 17 + 5 commas = 22 + 9 commas = 31 + 8 commas = 39 + 9 commas = 48 + 5 commas = 53.

pairing off the commas as it were, so that more than one scale was available. This pairing of a note was called *tempering* it, and any system by which particular notes are tempered is called a "*temperament.*"

In the fifteenth century a Spaniard, named Ramis, urged the introduction of the tempered scale. Up to this period, the semitones, or black notes, were tuned either as *sharps* or *flats* to their immediate neighbours, for instance, the one representing F *sharp*, could not be used as G *flat*.

As is always the case when even the most obvious advantages are to be gained, there are to be found many persons willing to oppose any advance, so for a long time this change in temperament was fought over by *savans*, who argued that all purity would be lost if the scale were so tuned; but as musical composition became more complex so it was found to be cramped in performance by the scales. Only a few were available for composition, enharmonic changes were unknown, and so at last this "unequal" temperament was gradually forced into use, by the necessity of the practical bearings of the case.

The actual defects of the unequal temperament are very interesting, but we have not the space to go fully into the matter here. As every black note was either the *flat* of the white note above it, or the *sharp* of the one below, it followed that many keys were out of the question altogether—for instance, as there was a G *sharp*, but no A *flat*, the beautiful keys of E *flat major* and A *flat major* were excluded. For in no case did a black note do duty for the *sharp* of the note below, and, at the same time, the *flat* of the note above.

These defects of scale or temperament were felt by composers. They were prevented from writing, or, at least, performing, many elaborations; and even in the sixteenth century the Italians endeavoured to remedy the defect to some extent by dividing the black keys on the manual so that one half should sound one note, and the other give another. It will be remembered that these "*quarter tones*," as they were called, were introduced by Father Smith into the Temple organ. These extra notes were A *flat* and D *sharp*, and the scales made available were E *flat major*, C *minor*, and E *minor*. In a previous chapter we noted several attempts to enhance this advantage by a further division of the notes, but the increased difficulty of execution, as well as the great room required for the extra pipes and necessary mechanism, not to mention the enormously increased expense, put any complete arrangement out of the question.

When we consider the extreme simplicity of the equal temperament, and the immense advantages attending its use, it seems difficult to understand why it did not at once occur as the easiest way out of the difficulty. It was clear that no instrument could be made that could be played upon by an ordinary performer that had a perfect scale in each key, and the question was, could not the twelve semitones be so divided as to, at once, make all keys alike for composition, and at the same time not offend the ear? About the beginning of the eighteenth century the battle of temperaments commenced, and it is to the great Sebastian Bach that we owe the introduction of the present mode.

'The advantages of the modern system, known as the equal temperament, are so well known that we need only recapitulate them.

(*A*) the *semitones*, twelve in number, are divided equally; therefore (*b*) all the twenty-four keys are equally available—thus then (*c*) any *semitone* may be taken as a key note—and (*d*) any change may be made enharmonically, that is to say, a change of notation does not imply a change of intonation or sound.

It will be seen now what great enharmonic advantages hang on this system, for any change may be made without offending the ear in the slightest degree, for, although in theory an enharmonic change is a change of sounds, yet in practice such an arrangement would be intolerable.

Take any note in the scale, and it will be seen that it can be made to serve many purposes—for instance, a note may be F *natural*, E *sharp*, or G *double flat*, yet it is only changed on *paper*.

To prove the advantages of this system, Bach wrote his marvellous and beautiful set of piano *Fugues*, consisting of forty-eight *Preludes and Fugues*, bringing into play every key, hitherto it will be remembered many of them having been quite unused. Bach used to tune his own instruments in accordance with this then new theory, and it is said that listeners could scarcely comprehend that in the easy modulations they were hearing the performer was bringing into his service remote keys, then looked upon as quite foreign.

It was argued in favour of the old temperament, that although some keys were unused, yet those that were in use, were more pure and natural than the same or any keys of the new method—this was true, but we doubt if there are any except the most highly trained ears that would detect any serious flaw.

It should be mentioned that the jarring that occurs in the unequal temperament when remote or unrecognised scales are called into play, is called a "wolf," in the equal temperament there is, therefore, *no "wolf" whatever*, all keys being equal, unless it be insisted that there is *always* a "wolf."

After what has been said on the subject of temperament, it is curious to find still some eminent musicians adhering to a system that in no way is up to the *necessities* of modern music. Nevertheless, there are many large instruments still tuned on the unequal principle—the organ at Wells Cathedral, by Willis, has only very lately been modified—but it must be distinctly stated that the great majority of organs are on the new principle now-a-days. All orchestral and town hall instruments, as well as nearly every church organ of repute, are tuned on the "*equal temperament.*"

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CHAPTER XXV.

Tuning.

TUNING the organ, or, indeed, any keyed instrument, is such a very delicate operation, that before entering into the *modus operandi* we would warn all amateurs not to attempt to tune any valuable instrument without having had practice in the art. Indeed, it is far better to leave such a difficult matter to those whose business it is continually to be at the work. More especially does this apply to the first operation, or "laying the bearings," as it is called.

We shall only describe the mode of tuning necessary for the equal temperament, inasmuch as this is now so universal that it is the only method likely to be adopted in any instrument for general use.

It is usual to tune the *Principal* on the great organ, and then tune *all* other stops to it. When, therefore, an organ is to be tuned throughout, it will be necessary to adjust the first note C to a pitch-pipe or fork which is of the required pitch for the instrument. We treat of pitch in a future chapter (XXVII); so that, assuming that point to be settled, we have our primary C tuned.

There are several methods of tuning the other notes to this C, and it will be obvious that the easiest way to do would be to get an octave correct, and then proceed with all the other pipes in octaves, precisely as in the case of the piano.

Perhaps the easiest method is to use only the intervals, the *fifths* and *octaves*. In this way a perfect scale may be produced with less complication than when the *thirds* and *fourths* are brought into play.

The rule to be followed is that *fifths* should be *flat*. The way to flatten fifths is to tune first perfect, then so far to reduce the interval that distinct slow waves may be heard; then the octave of the *fifth* just adjusted, perfect, then the fifth of that octave flat as the first, and so on according to the plan shown on the Tuning Scale (Fig. 66), which represents all the tuned notes as black, and all the untuned notes, or those about to be tuned, as white. On coming to the F natural the system must be reversed, and this note must be tuned just as sharp to the C above as were the others flat. In other words, the interval must be reduced in the same degree. This latter mode must also be adopted in the case of the B flat and final E flat.

During the operation of laying the bearings it will be necessary from time to time to use trial chords of such notes as have been already tuned, in order to satisfy the ear that they are properly tempered to their fellows. These chords are called "proofs," and will be suggested from time to time.

If the tuner desires to use thirds, &c., in his scheme, the following rules must be rigidly kept: *All octaves perfect, major thirds sharp, minor thirds flat,* and *fourths sharp.*

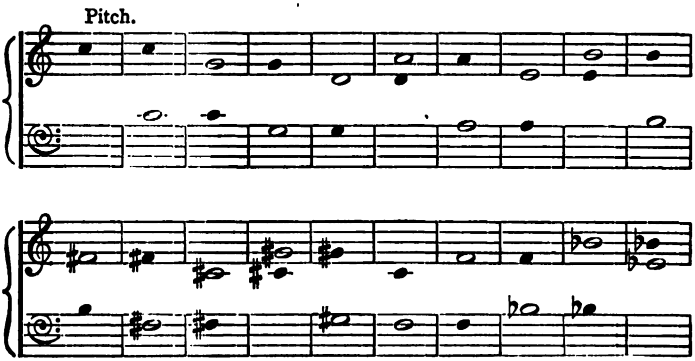

FIG. 66. TUNING SCALE.

Having laid the bearings, and tuned the *Principal* throughout, the stops furthest from the operator should be taken next in order. This is done to avoid having to stoop over, or in any way interfere with an already tuned pipe. The reeds are always left to the last, for they should be easily attainable, and require extra touching up more often than do the flue stops.

The instruments used in tuning are of an extremely simple character. They consist of *Tuning Cones* of various sizes, *Horns*, and the *Reed Knife*, as also of *Mops* of different dimensions. (Figs. 67 to 70).

The causes which determine the pitch of flue-pipes have already been explained (*ante* pp. 128, 140). To sharpen a metal flue pipe the bell of the tuning horn is pressed on to the top, so as to make the opening of smaller dimensions. To flatten the pipe, the cone is tapped into the top, the aperture is thus widened, and the sound flattened. Closed metal pipes are tuned by means of an adjustable slide, which lengthens or shortens the pipe as may be required. For closed pipes of wood, the stopper is raised to flatten and depressed to sharpen. Flutes and some square pipes of wood are tuned by means of a sheet of lead which is made to project over the top, so that by placing this nearer the opening the pipe is flattened, and by removing it it is sharpened. The *Keraulophon* and some few other delicate stops are tuned by a slide at the upper end of the pipe. Then, again, it sometimes is found well to tune delicate stops by means of ears, that can be brought more over, or farther from the mouth, as may be required. The large metal *Diapason* pipes, as also all the show pipes, are tuned by a slit in the back, with a tongue, which enables this slit to be lengthened or shortened at pleasure.

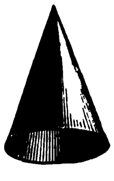

FIG. 67.
TUNING CONE.

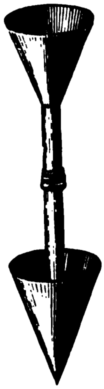

FIG. 68.
HORN.

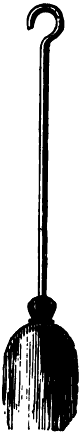

FIG. 69.
MOP.

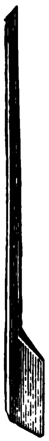

FIG. 70.
REED KNIFE.

Pedal pipes of wood are tuned by having a bit of board nailed over the top or upon a large slit.

In *Mixtures* and compound stops that have more than one pipe speaking at a time it is usual to employ various sized mops to silence those pipes that are not being tuned, but the best method of managing these is to arrange that each row of pipes of a compound stop shall have a separate slide, so that the tuner may effectually silence all the ranks he does not require.

The reeds are tuned with an instrument called a *Reed Knife*, which is a rod of steel with a very blunt blade, as represented in the figure. With this the wire which rises from the boot is depressed to sharpen or raised to flatten the note. The more delicate and the smallest pipes of the reed department are sometimes adjusted by a cap over the top, but this so affects the calibre of speech that it is not well to alter its position if by any means the wire can be utilised.

CHAPTER XXVI.

Distinction in Keys.

HAVING in Chapter XXIV. shown that in theory all scales are absolutely alike (*i.e.*, if the instrument be tuned upon the modern system of equal temperament), it would at first sight appear that, no matter which key was selected for the performance of a passage, the effect on the ear would remain unaltered in character, the pitch only differing according to the scale used. But, on the other hand, every person who has even a rudimentary knowledge of music is well aware that each scale throughout the gamut has most distinctive characteristics, and an ear comparatively untrained can almost always appreciate the difference between scales of sharps or of flats.

Of course, in the old unequal temperament, as soon as the performer wandered away into any key save those few that were allotted him, the clashing of mixed intervals gave him a "character" that warned him at once of his position; but the fact is, no one quite seems able to tell us why our modern scales have each their own distinctive qualities; why it will not do to play a solemn passage in B natural.

No matter with what precision the tuner exercises his art, with what skill he lays his bearings, still there remains the distinct character of each key, unaltered and standing forth, almost as if each were tuned on purpose to produce given results. It must not be imagined that keys differ so much in themselves as to bear no resemblance to each other; the truth is that every key resembles more or less some other, but even those most alike have individual features, whereas those at either end of this differential scale seem hardly to be of the same family, so remote is the likeness.

This difference of key has been rather overstated by some authors, but the following is a fair *résumé* of the chief character attributed to the ordinary keys more usually to be met with:

C Major.—Bold in style, and much used for marches, &c., and for prominent or pronounced themes. ("Gloria," Mass 12.—Mozart.)

C Minor.—Plaintive, with the character common to all minors, but hardly mournful. ("Qui Tollis," Mass 12.—Mozart.)

D Major.—Vigorous and spirited. A great favourite for vocal chorus. This key is, in fact, the highest choral scale in use. ("Hallelujah Chorus," "Messiah.")

D Minor.—Fine and solemn.

E Major.—Very joyous and spirited, but also capable of great expression. This key might be called incisive in character. ("I know that my Redeemer," "Messiah.")

E Minor.—Grand and spirited minor key, very useful for solemn martial work. (Mendelssohn's "Lieder," "March of the Knights Templars.")

F Major.—A most useful key, quiet and smooth. A very great favourite with all composers, and capable of great and varied expressions. ("He shall feed His flock," "Messiah.")

F Minor.—A pliant key, sad and wailing, not often used.

G Major.—Perhaps a little commonplace, but most useful; not so bright as D or E major, but brighter than F major. Frequently used for all kinds of work.

G Minor. —Most beautiful key, melancholy and grand. This key is, perhaps, as fine as any of the minors, and has been used for some of the finest passages of our great composers. (Prayer in "Mosé in Egitto.")

A Major.—Very fine, bright and sprightly. It is a general favourite, and may be found expressing the thoughts of all our composers when they have desired a bright and flashing effect. ("Sonata to Haydn," first movement.—Beethoven.)

A Minor.—Most delicate, often used as the complementary minor to C. Mendelssohn wrote some of his best Lieder in this key.

B Natural.—Uncommon key, but very incisive and lively. This key has hardly had justice done to it, as it is so very bright. In organ music this may be accounted for by the want of profundity of the bass note.

B Minor.—Like all the minors, wailing, but not so pathetic as its fellows. ("O God, have mercy!"—Mendelssohn.)

D Flat Major.—A very fine and grand key, used to express some of the tragic ideas of our great masters; not so popular as it should be.

E Flat Major.—A key that gives an expression too well known to want description. This scale is capable of the most exquisite expression, and is a general favourite. Some of the best of our great works are in this key. ("If with all your hearts," "Elijah.")

A Flat Major.—This key deserves special notice as being the great outcome of our present system of tuning. In the unequal temperament it was not to be used, but with us it has become the most popular of all keys for expressing sad, melodious, and tranquil ideas. It is beautiful to a degree, and has a character of its own. It is difficult to choose any one example, but, perhaps, that "Lieder ohne Worte," beginning Mendelssohn's 4th book, gives as good a specimen of its effect as any.

B Flat Major.—Not by any means so pleasing as the last. It is often used by all composers, and is a quiet, inoffensive key, with nothing particular save its dulness to recommend it.

The above are the ordinary keys, with their peculiarities. As we said, no one can quite account for the differences, but there they are.

CHAPTER XXVII.

The Variations of Pitch.

PERHAPS there is no point that has been more disputed among musicians than that of "pitch," and even now it has only been settled with respect to this country in a slipshod manner, and without serious regard to natural acoustics.

The gravity or acuteness of a note is termed its "pitch." Notes having the same number of vibrations are of the same pitch. There is a standard for this country from which all instruments are tuned for so-called "concert" pitch. This note is the C, having 528[*] vibrations per second. The point was so far settled at a meeting of the Society of Arts, 5th June, 1860; but according to Sir John Herschel, the natural divisions of notes rise from one vibration per second by octaves thus, 1, 2, 4, 8, &c., under which arrangement the natural pitch of that C would be 512 vibrations per second, so that the present concert pitch is really sixteen vibrations above the natural one.

With regard to the pitch to which an organ should be tuned, there are so many matters to be considered, that it is not at all settled which is absolutely the best method of proceeding. Of course the question of orchestral organs, pure and simple, such as are in halls, public places, &c., where they would frequently be required in harmony with an orchestra, is settled by the pitch above alluded to, and to which all concert music, &c., is played. But for congregational and general music, the present pitch is considered trying. It will be interesting, therefore, to observe some of the differences that have arisen in this particular, and also to note the several theories that are supposed to account for some very remarkable variations with regard to the standards that have been found prevalent at different times and in different countries. Many persons are of opinion that for at least two hundred years the musical pitch has been gradually rising, and that in the time of old Father Tallis it was about two tones below our present standard. That such could hardly be the case is manifest when we see how very low the music of that period is scored. It is with difficulty that some bass passages are sung, even at the present pitch, and it is not probable that the scale of the human voice has changed. Indeed, this last idea has been seriously argued, but it is utterly untenable to thinkers. The voice is perhaps the most perfect piece of mechanism in the body, and the idea that in so short a time nature should have found sufficient cause to make so great and important an alteration is scarcely probable.

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[*] The actual fork made as a standard turned out to be C=534·5.

The best solution of this difficulty seems to be that in the sixteenth century there were two distinct pitches. The ordinary one, if we may use the term, was low; whereas the ecclesiastical pitch was actually higher than our present one. This is borne out by the fact that in Germany it is found that the old organs built about that period were at least a tone above our pitch. It seems that in that country there were no less than three standards, called severally the Orchestra Pitch, which was the lowest, the Chamber Pitch, which was slightly higher, and the Church Pitch, which was the highest.

Mr. Hopkins, who has gone thoroughly into the question, points out that the very low notation of church music is almost a proof that a high pitch was used in the churches.

It is interesting to note that Father Smith, who always tuned his organs to a lower pitch than the old supposed one, chose what is really the mathematically correct standard.

The pitch then gradually became lower, and exactly as this advanced, so did the notation in proportion become higher. Hence, by following the music written between the two extreme periods, we can with some degree of accuracy trace the gradual but steady fall of the pitch.

But with regard to the organ in particular, the great point of importance is, What pitch is to be chosen now?

Although organs and pianos are tuned to C, it must be remembered that the majority of musical instruments are tuned to A, so that it is convenient to take this note as the standard when speaking of various pitches, and, where necessary, reduce the number of vibrations to the note C by rule of three. The following relations will be a guide. In equal temperaments, the note A, giving 444 vibrations per second, corresponds to the C giving 528, and conversely. In giving the old pitches it will be well to remember that the only method we have of carrying pitch is by means of the organ pipe or the tuning fork, the latter dating only from 1711, so that prior to this date the organ pipe was the only means of determining the pitches to which instruments had been tuned. Both pipe and fork alter with temperature, the former becoming sharper as the temperature rises, the latter somewhat flatter.

The pipe alters by one vibration for every thousand for one degree Fahrenheit, nearly; this therefore necessitates that for taking standards or accurate notation of pitch, organs should be reduced to a fixed temperature; the fork alters only about one vibration in 21,000 for each degree, so that practically this deviation may be ignored.

Mr. Alexander Ellis has entered very fully and exhaustively into the subject of pitch, and the result of his labours has been given to the public in some interesting articles appearing in *Nature* (1880). We are indebted to him for the following *résumé*, which is, in fact, a condensation of all that need be said with regard to the various pitches that are known.

At present almost all organs, not ordered otherwise, are tuned to what corresponds to an old medium pitch, to be heard on an old organ at Hampton Court Palace, and on the organs of St. Paul's Cathedral and Westminster Abbey, as at present tuned. It is in reality what the Society of Arts intended theirs to be.

CONDENSED HISTORY OF MUSICAL PITCH.

1. *Church Pitch, Lowest.*

A.
370 ... Zero pitch, not observed.
374 ... L'Hospice Comtesse, Lille.
377 ... Schlick low, 1511; Bédos, 1766; French C foot organs.

2. *Church Pitch, Low,*

391 ... A. Silberman, Strasburg Minster, 1714.
392 ... Euler's clavichords, St. Petersburg, 1739.
395 ... Trinity College Organ, 1759; English C foot organs; Roman pitch pipes, 1720.
396 ... Versailles Chapel, 1789; French B foot organs.

3. *Chamber Pitch, Low.*

404 ...Roman pitch, 1730, from a fork.
407 ...Sauveur, Paris, 1713.
408 ...Mattheson, Hamburg, 1762.
409 ...Pascal Taskin, Paris, Court Clavecins, 1783.

4. *Mean Pitch for Two Centuries, English B foot Organs.*

415 ... Chain fork of the Roman Catholic Church organ, built by G. Silbermann, 1722.
418 ... Same organ in 1878. Euler's organs, 1781.
420 ... G. Silbermann's Freiberg organ, 1714; Torje Bosch's Seville Cathedral organ, 1785; and all church organs in Spain.
422 ... Stein's fork for Mozart's pianos, 1780; Lower resonance of Cremona violins, 1700; Old fork at Lille, about 1754; Verona and Padua, 1780; Russian Court church band, 1860.
423 ... Handel's fork, 1751; Green's St. Katharine's, 1778; and Kew, 1790; Dresden Opera under Weber, 1815-21; Paris Comic Opera, 1820.
424 ... Prætorius's "suitable" church pitch, 1619; Original Philharmonic Concerts, 1813-1828.
427 ... Paris Grand Opera, 1811.
428 ... Renatus Harris's organs, 1696; Green's St. George's, Windsor Castle, 1788; Paris Comic Opera, 1823.

5. *The Compromise Pitch.*

433 ... Sir George Smart's fork, 1828.
434 ... Paris Grand Opera, 1829.
435 ... French Diapson Normal, 1859.

6. *Modern Orchestral and* **Ancient Medium Pitch.*

440 ... Paris Conservatoire, 1812; Paris Opera, 1829; Scheibler's Stuttgart pitch, 1834; Dresden, 1862.
442 ... *Father Smith's (=Bernard Schmidt's) low pitch at Hampton Court Palace, 1690; English B flat foot organs.
443 ... Bologna, Liceo Musicale, 1869.
445 ... Madrid Opera, 1858; Naples, S. Carlo, 1857.
446 ... Broadwood's medium, 1849-80; Paris, Grand Opera, 1856; Griesbach's A 445·7, 1860, for Society of Arts, meant for A 444.
447 ... Vienna Opera, 1878.
449 ... Paris Grand Opera, 1858; Leipzig, Gewandhaus Concerts, 1859; Griesbach's C 534·5, 1860, for Society of Arts, meant for C 528.
451 ... Lille Opera, 1848 and 1854; British and Belgian Military Instruments Standard, 1879; Higher resonance of Cremona violins, about 1700.
453 ... Mean of the Philharmonic Concerts under Sir M. Costa, 1846-54.
455 ... Highest Philharmonic, 1874; Broadwood's, Erard's, Brinsmead's, and (English) Steinway's concert pianos, 1880.
456 : Vienna celebrated high pitch before 1859.
457 ... (American) Steinway's pianos.

7. *Church Pitch, High.*

458 ... Vienna, large Franciscan organ, 1640.
474 ... Tomkin's standard, 1668; Father Smith's high pitch at old Durham and old St. James's Chapel Royal organs, 1683 and 1708; the Jordans, at St. George's, Botolph Lane, 1748; English A foot organs.
481 ... St. Catherine's, Hamburg, 1543.
484 ... Old smaller organ in Cathedral, Lübeck.
489 ... St. James's (S. Jacobi), Hamburg, original pitch, 1688.

8. *Church Pitch, Highest.*

494 ... St. James's (S. Jacobi), Hamburg, present pitch, 1879.
496 ... Rendsburg organ, 1668.
504 ... Schlick's high pitch, 1511; Mercenne's *ton de chapelle*, 1636.
506 ... Halberstadt organ, 1631.

9. *Church Pitch, Extreme, and Chamber Pitch, Highest.*

563 ... Mersenne, *ton de chambre*, 1636.
567 ... Usual church pitch in North Germany in 1619, called chamber pitch by Prætorius. Probable pitch of church music of Orlando Gibbons (1583-1625).

Taken as broadly as possible, it perhaps should be laid down as law that all organs should be tuned to the present standard concert pitch, *i.e.*, C = 528 vibrations per second. Under these circumstances, if the worst comes to the worst (and in church singing this pitch is found trying), it is no very difficult matter to transpose the music a semitone or even a whole tone, and there will always be the satisfaction of having the recognized standard concert pitch, if at any time it should be required. We must not lose sight of the fact that gradually the orchestra is being introduced into our churches. A few years ago it was only at a few of the larger and more important Roman Catholic churches that the orchestra was occasionally heard at festivals, but the favour that this introduction gained was so marked that imperceptibly it has gradually come about that in the Established Church, as also in some of the more important chapels of other sects, the orchestra has made its way. The performance of Bach's *Passion Music* at St. Paul's Cathedral, and afterwards at St. Anne's Church, Soho, was the first great step in this direction, and the manner in which the public flocked to get admittance spoke volumes as to the popularity, at any rate, of the movement. Indeed, on the second performance, it was found necessary to admit only by tickets, and even then the church was full to overflowing.

Putting aside, then, those organs that are erected with a view to the part they may play at public performances of large scale, at concerts, &c., it may often happen that a church organ is called upon to combine with other instruments, so that unless there is no probability of such an occurrence, it would always be better to choose the concert pitch. If, on the other hand, an organ were to be erected with a view to assisting the voice and that only, where repeated and continued vocal music was to be given, there would be no special reason why a pitch slightly lower might not be chosen, say, perhaps, the C to have the natural 512 vibrations.

We ought most certainly to make these great points questions of international arrangement. It is undoubtedly a matter that spreads far beyond the confines of any one country, and until there has been settled some permanent pitch for all civilized countries, so long will there be petty discussion as to "which is best."

CHAPTER XXVIII.

The Size of Organs.

It is of the utmost importance that an organ should be of such a size and power as to be able to fulfil those duties it will be most frequently called upon to perform. With regard to large instruments, used for orchestral purposes, for Cathedrals, &c., this will, as a matter of course, be duly considered, and money and space being more or less at command, there is seldom much doubt that the instrument will be able adequately to perform its part throughout the usual routine of its work. According to the place and means, so will such an organ be more or less perfect. It will have a Solo organ or not, it will possess many of the less common stops, and have those accessory arrangements that may not be looked upon as actually essential to an ordinary organ. In the case of large public buildings, or well attended and carefully managed places of worship, no organ would be erected without due consideration of all the duties it will from time to time be called upon to fulfil, so that we find magnificent instruments, with every possible accessory for easy manipulation and variety of performance, at all those places where different organists and orchestral works are most likely to be heard. But when we come to the smaller buildings, where the organ is to play a subordinate part, for the leading of voices, &c., it is often the case that an instrument is erected which, valuable as it may be from one point of view, nevertheless might have been made of greater use as a choral adjunct for the same or even a less outlay than had arisen.

It is quite surprising how little actual work there need be in an instrument to make it at once a complete and capable means of leading large bodies of voices, and in building and planning small organs it often happens that those improvements that have within the last century become so common are looked upon as essential, so that many a poor church or mission chapel goes without an organ, because it is supposed that a seemly instrument for so large a congregation cannot be obtained for a given sum that might be raised. This idea is erroneous, and the sum of money expended on a large harmonium would amply suffice to place an organ of sufficient power for all the requirements of the place. First, then, be it understood that the Swell, the Choir, and even the Pedal organs, are all mere accessories to an organ that is intended only for vocal or congregational singing, and a few good solid stops will produce all the tone and all the power necessary to lead an immense body of voices. It must not be inferred from what we have just now stated that a large organ is useless—quite the contrary; but what we want to convey is, that a comparatively small instrument may be so constructed as to be capable of giving the lead to large congregations. It must have been noticed by almost all persons who are not versed in the science of music that in an ordinary quartet of four voices for *soprano*, *alto*, *tenor*, and *bass*, the treble is always heard more distinctly than any other part; and, again, that if an air is played on any instrument an octave above the usual pitch, it becomes at once more prominent. This is not because the treble notes are stronger than the others, but because they are of a higher intonation. In point of fact, the higher a note is the weaker it becomes; but the pitch has a great deal to do with the manner in which we appreciate it, so that a treble voice of weak character is heard above the strongest bass. Thus, then, with the organ; a stop of small weak pipes can be heard above all the lower and more ponderous stops, or above the largest congregation of adult singers.

If, then, we construct an organ with one or two well voiced unison stops, these go to support the treble singers. Double stops, say a Double Diapason, would assist and help the bass voices, and the addition of a Principal, a Fifteenth, or, after that, a Mixture, would be found ample to bring out the organ tone, so as to *lead* the whole voices. Of course, the addition of Pedals is an advantage, for if to the above a Pedal Stop be added, with also a Pedal Coupler, the full effect of that department, insomuch as accompaniment requires, may be attained. Let it, then, be remembered that unison stops assist trebles, double manual stops help the basses, while the octave stops give prominence and *lead* the voices, and the pedal marks the progress of the music with precision.

It is hardly necessary here to point out how superior is the tone of the organ to that of any other instrument that can be substituted. Of course, the harmonium is a mere apology for its absence, whereas other instruments lack not only the tone, but the sustaining power that makes the organ of such great value to all choirmasters. We then come to consider the kind of organ that it would be advisable to erect for the leading of a congregation. Let it not be thought we recommend that only such an organ as we here specify should be erected in a Church or Chapel of a size for its congregation, but that where means for a complete instrument are wanting, such a one as will meet the requirements of the singing can, with judicious arrangement, be erected for a small outlay.

There is one point that cannot be too well remembered by those whose duty it may be to provide an organ for any permanent building, viz., that if the instrument be planned accordingly, it will not be necessary to build it all at once. There can be no graver error than to attempt to add this and that to a complete instrument. In the first place it is an injustice to the original designer; for if it were so constructed as to balance properly, it is obvious that any alterations or additions cannot but break such a balance, and do away with the effect of the complete tone; then if the instrument has been finished in the first instance, it will be impossible to add anything of importance without disturbing all the previous arrangement and the contents of the whole instrument, and this, as a rule, leads not only to the imperfection of whatever addition may have been effected, but also to the spoiling of what good work there may have been in the organ at the outset. But in planning organs for small buildings, as well as for large, it is well to devise such an instrument as will be best for the surroundings, to complete the necessary mechanism for the whole, and insert then the principal stops as far as means will allow, always having the skeleton of the instrument so far completed that at any time additions may be made without altering the scheme, or disturbing existing parts. By this means a suitable organ can almost always be built in the course of a few years; whereas if a complete instrument is insisted on at first, there is the unavoidable loss occasioned by having to get rid of the old organ second-hand when the time has arrived for the erection of such a one as should have been at first arranged.

Something has been said with regard to the compass necessary for these small organs, and although there can be no doubt that it might be curtailed without any great disadvantage, still we can hardly *recommend* that any save the usual compass from C C to A in alt be adopted; and this because if the full compass be allowed the power remains to the organist to play any passages in octaves, so as to bring up any tendency to flatness that may from time to time be evinced by the congregation.

The smallest organ that we would under any circumstances advise would consist of:

1. Open Diapason. 2. Stopped Diapason. 3. Principal.

And if to this could be added a small scale Bourdon, it would be found to give great weight to the effect without interfering with the ground tone.

For a larger instrument would appear:

1. Bourdon.
2. Open Diapason.
3. Stopped Diapason.
4. Principal.
5. Fifteenth.

And to this might be added a Pedal Coupler, and also a Diaocton or Octave Coupler, which would increase the upward range or tone, and, in fact, would, when in use, produce the tones of an organ constructed as follows:

1. Bourdon.
2. Open Diapason.
3. Stopped Diapason.
4. Principal.
5. Fifteenth.
6. Stopped Diapason.
7. Principal.
8. Flute.
9. Fifteenth.
10. Octave Fifteenth.

Instead of the addition of Fifteenth, a two-ranked Mixture would be of use, and such an organ would sustain from 400 to 500 voices with ease.

Each of the specifications hitherto given would be of more value if enclosed in a Swell-box. When the whole of a small organ is thus encased, the arrangement is known as a "General Swell" (*vide ante* p. 123). The advantages of this are manifold. In the first place, it keeps out dust, for all the pipes being within the box, and therefore subject to the same temperature, there is no necessity for leaving the Swell pedal down (as is the case in a larger instrument of two manuals), unless it so happen that violent changes of temperature are likely to occur, when it is always wise to observe the general rule, and allow the external atmosphere free access to the pipes. Again, a "General Swell," though not taking from the power of the organ, gives to the performer the option of playing any passage more softly than he otherwise could had he not this addition.

It would hardly be advisable to construct a larger organ than that last given for the mere accompanying of voices, so that when it is decided to erect a more complete instrument we find ourselves among the range of organs proper, and with the choice of all and every of the many complications to which a finished instrument may aspire. We can, therefore, now pass on to consider the proper size of organs for small buildings, such as country churches, chapels, &c., where it would be desirable to have an instrument capable of giving some little colour to the service, besides merely accompanying the singing. Here we should have two manuals; and before going on to specify such an instrument we would point out a great mistake that is only too frequently made, that of curtailing the Swell at Tenor C.

Where this is permitted, there is no possibility of playing any passage of ordinary limits upon the Swell only, and a great part of the utility of this portion of the instrument is lost. It is always advisable to carry a manual to its entire compass, even at the sacrifice of some stops.

This may always be done with more or less ease without altogether incurring the expense concomitant with the lower octaves of the larger stops; thus, by grooving an open 8ft. stop into the bass octave of a stopped set of pipes of a similar tone-length, or even by borrowing a bass octave from the Great Organ, the gap may be in a great measure filled; nevertheless we cannot but assert that it is always better, as far as possible, to have the smallest organs complete as far as they go. In a case where the abridgement at tenor C is unavoidable, there should always be an Octave Coupler from Great to Swell, so that by putting down the C C pedal, the Swell C may also be influenced.

There are so many small organs about the size required for such a building as we have mentioned above, that instead of giving any special instrument, we draw up a specification that may be more or less altered according to circumstances.

GREAT ORGAN.

1. Open Diapason	8ft.
2. Stopped Diapason	8ft.
3. Dulciana (or Salicional) to tenor C	8ft.
4. Principal	4ft.
5. Fifteenth	2ft.

SWELL ORGAN.

6. Open Diapason, to tenor C	8ft.
7. Lieblich Gedact	8ft.
8. Principal	4ft.
9. Mixture (Quint and Fifteenth)	II. ranks
10. Oboe	8ft.

PEDAL ORGAN.

11. Stopped Pipes	16ft. tone

ACCESSORIES.

Couplers—1. Swell to Great.
2. Great to Pedal.
3. Octave Coupler-Pedal.

No. 3 is grooved into bass of No. 2, No. 6 is grooved into bass of No. 7.

To the above may be added with advantage a coupler, Swell to Pedal, as also a Diaocton, or Octave Coupler on the Swell.

The advantage gained by having an Octave Coupler to Pedals is, that the effect of an 8ft. Flute is produced on that department. The addition of a Diaocton to the Swell would necessitate the carrying up of the stops to the limit of the extra octave, but would well repay the outlay. Finally the coupler, Swell to Pedal, although adding to the expense and complication, gives the very great advantage of a suitable bass being easily commanded from that portion of the instrument.

A step farther takes us to that form of two manual instrument to be found in a large number of Churches, &c., throughout the country, and as a specimen we choose that in St. Mary's, Prittlewell, Essex, built by Messrs. Bishop and Son, 1876.

GREAT ORGAN.

1.	Open Diapason	8ft.
2.	Clarabella	8ft.
3.	Dulciana	8ft.
4.	Viola	8ft.
5.	Harmonic Flute	4ft.
6.	Principal	4ft.
7.	Fifteenth	2ft.
8.	Mixture	III. ranks

SWELL ORGAN.

9.	Double Diapason	16ft. tone
10.	Open Diapason	8ft.
11.	Gedact	8ft.
12.	Principal	4ft.
13.	Harmonic Piccolo	2ft.
14.	Mixture	III. ranks
15.	Oboe	8ft.
16.	Cornopean	8ft.

PEDAL ORGAN.

17.	Open Diapason	16ft.
18.	Bourdon	16ft. tone

ACCESSORY MOVEMENTS.

Couplers—1. Great to Pedal.
2. Swell to Pedal.
3. Swell to Great.
Two Composition Pedals to each manual.

No. 9 is not of open pipes, but stopped wood of 16ft. tone. Spotted metal has been used throughout the entire metal work, and the compass is from C C to G^3 on the manuals, and from C C C to F on the pedals.

By means of a suitable number of combination pedals, we can dispense with the Choir or third manual without so much inconvenience as at first might be supposed, so that if the stops are of a proper character, and of sufficient variety, a very fair instrument for almost all purposes may be obtained having two manuals only. Between the last specification and the one below there is a rather wide gulf, but there are few who are not acquainted with organs of two manuals that would go to furnish them with data as to the capabilities of such instruments. We therefore give as a final instance of two-manual work the schedule of the organ in the Bow and Bromley Institute, by Messrs. Brindley and Foster, Sheffield. This instrument has been previously referred to, and is of interest as being one of the few organs in a public hall having only two manuals, and also as possessing ventil combination pedals.

The organ is found to be of ample power and capacity for the hall in which it is placed, and it affords an example of how well a moderate instrument, if properly schemed, may be made efficient for the class of work that instruments in such places are likely to be called upon to do.

GREAT ORGAN.

1.	Bourdon	16ft.
2.	Open Diapason	8ft.
3.	Lieblich Gedact	8ft.
4.	Hohl Flöte	8ft.
5.	Vox Angelica	8ft.
6.	Principal	4ft.
7.	Flute Harmonic	4ft.
8.	Grave Mixture	II. ranks.
9.	Full Mixture	III. ranks.
10.	Trumpet	8ft.
11.	Clarionet and Bassoon	8ft.

SWELL ORGAN.

12.	Lieblich Bourdon	16ft.
13.	Open Diapason	8ft.
14.	Lieblich Gedact	8ft.
15.	Viol di Gamba	8ft.
16.	Voix Celeste	8ft.
17.	Principal	4ft.
18.	Piccolo	2ft.
19.	Full Mixture	III. Ranks.
20.	Cornopean	8ft.
21.	Oboe	8ft.

PEDAL ORGAN.

22.	Contra Bass—Metal	16ft.
23.	Sub Bass—Wood	16ft.
24.	Principal Bass	8ft.
25.	Flute	8ft.
26.	Trombone	16ft.
27.	Trumpet	8ft.

COUPLERS.

Five couplers, worked by small pedals, as follows:

1. Swell to Pedals.
2. Great to Pedals.
3. Swell to Great.
4. Swell-sub-Octave on Self.
5. Swell-super-Octave ditto.

ACCESSORIES.

Seven ventil Combination Pedals; four on Great and Pedal Organs, acting simultaneously, the other three on Swell.

The great advantage of three-manual instruments, over those having only two, is that an accompaniment may be arranged on the Choir manual for either of the other departments, one of the latter being ready to take up the strain with a totally differing arrangement of stops. For instance, a solo may be arranged for a flue stop on the Great Organ, coupled, perhaps in octaves, with a reed on the Swell, and accompanied by the Choir; or the Great and Swell manuals may be full and kept for *ff* passages, while the Choir is ready to take any short soft phrase that may occur. So that whatever may be done by means of composition pedals with a two-manual instrument, it still falls short, in point of variety, of the organ with three claviers. Hence we find often that a comparatively small three-manual organ is preferred to one of greater power without the additional department. We, therefore, give an ideal organ of this class, which would be suitable for a chamber or small church, and then a couple of existing instances of three-manual instruments such as are of most use in ordinary places of worship. We must not omit to mention that it is usual to have on the Choir Organ a few stops that will serve well as solo effects. This department is thus made, as far as possible, to answer the purpose of the Solo manual of the larger instruments. Not the least advantage to be derived from three-manual instruments, as opposed to those of two manuals, is the coupling of the Choir and Swell Organs which, under many circumstances, is most expedient.

For chamber or small space, the following would form a useful combination:

GREAT ORGAN.

1.	Open Diapason	8ft.
2.	Stopped Diapason	8ft.
3.	Violin Diapason	8ft.
4.	Principal	4ft.
5.	Fifteenth	2ft.
6.	Trumpet	8ft.

SWELL ORGAN.

7.	Open Diapason	8ft.
8.	Hohl Flöte	8ft.
9.	Gemshorn	4ft.
10.	Harmonic Piccolo	2ft.
11.	Mixture	III ranks.
12.	Horn or Oboe	8ft.

CHOIR ORGAN.

13.	Open Diapason (to tenor C)	8ft.
14.	Lieblich Gedact	8ft.
15.	Swabe Flute	4ft.
16.	Dulciana	8ft.
17.	Piccolo	2ft.
18.	Clarionet (to tenor C)	8ft.

PEDAL ORGAN.

19.	Open Diapason	16ft.
20.	Bourdon	16ft.

ACCESSORY MOVEMENTS.

Couplers:—1. Swell to Great.
2. Swell to Choir.
3. Great to Pedals.
4. Swell to Pedals.

Three Composition Pedals: two acting on Great Organ, and one on the Swell.

In this specification Nos. 3, 9, 17, and 18, and even 6, might be omitted to make the organ less expensive.

What may almost be looked upon as the ordinary form of three-manual work, so frequently are organs of the calibre to be found, is made up of much the same stops as the foregoing; but the utility of the instrument is greatly enhanced by the addition of reeds in the Pedal, more stops in the Swell, and a greater number of couplers; as also invariably one or two 16ft. toned stops on the manuals. As an instance of such an organ, fitted, be it remembered, as well for a moderate sized hall as for an ordinary parish church, we shall cite the instrument in the Church of St. John of Jerusalem, South Hackney.

GREAT ORGAN.

1.	Double Diapason	16ft.
2.	Open Diapason	8ft.
3.	Hohl Flöte	8ft.
4.	Stopped Diapason	8ft.
5.	Octave	4ft.
6.	Super Octave	2ft.
7.	Twelfth	2⅔ft.
8.	Mixture	III ranks.
9.	Trumpet	8ft.

SWELL ORGAN.

10.	Bourdon	16ft.
11.	Open Diapason	8ft.
12.	Keraulophon (to tenor C)	8ft.
13.	Stopped Diapason	8ft.
14.	Octave	4ft.
15.	Super Octave	2ft.
16.	Mixture	III ranks.
17.	Cornopean	8ft.
18.	Oboe	8ft.
19.	Clarion	4ft.

CHOIR ORGAN.

20. Dulciana	8ft.
21. Viel di Gamba	8ft.
22. Stopped Diapason	8ft.
23. Gemshorn	4ft.
24. Flute (stopped wood)	4ft.
25. Piccolo	2ft.
26. Clarionet	8ft.

PEDAL ORGAN.

27. Open Diapason	16ft.
28. Bourdon	16ft.
29. Violoncello	8ft.
30. Trombone	16ft.

ACCESSORIES.

Couplers :—1. Swell to Great.
2. Swell to Choir.
3. Swell to Pedals.
4. Great to Pedals.
5. Choir to Pedals.

The instrument was built by Messrs. Gray and Davison in 1873, and the compass is—manuals C C to G_3, pedals C C C to E.

We now pass on to consider a specification suited to a larger building, a cathedral or exceptionally large church. It may be noticed that we do not add a larger hall; the reason is simply that in planning an organ, if it were to be built of this size and importance for a public building other than a place of worship, the arrangement of stops, as also their kind, would be materially altered. For the church we should want an organ of a different character from that required for a public building. In the latter the wind pressures would be of another calibre, there would be more solo stops, &c., so that the class of organs differs. The larger the instrument the greater is the gulf between them. Of church organs perhaps as good an instance as we can cite would be the organ in the parish church, Halifax, the following particulars concerning which instrument may be of interest: It was originally built by Snetzler, 1766, and then contained twenty-four stops, three manuals, no Pedal Organ whatever. In 1825 Messrs. T. Greenwood and Son put in sixteen toe pedals, acting on the Great Organ manual. In 1837 Mr. John Gray added an octave and a half of pedal pipes with pedal action, couplers—Choir to Great, and Swell to Great, four composition pedals, acting on the Great Organ, replaced the Vox Humana by a Dulciana, added to the Swell manual a lower octave of keys which acted on the Stopped Diapason of the Choir Organ. It was this builder who converted the Echo Organ into a Swell. Mr. Hill after this continued the improvement, extended the Swell pipes to gamut G, added a Double Diapason, and substituted ivory and ebony for the old mahogany keys. He removed the Trumpet in the Swell, substituting a Cornopean.

In 1851 the G Pedals were replaced by those of our modern compass —C C C.

In 1869 the entire organ was reconstructed into a C C C instrument, under the direction of Messrs. Hill and Son. It was now tuned on the equal temperament, a Gedact of 16ft. tone added to the Choir, a Double Trumpet to the Swell, as also a Clarion made out of the old Trumpet, and a Pedal Organ from C C C to F of the following stops was also added:

Double Open Diapason	32ft.
Open Diapason	16ft.
Bourdon	16ft.
Violoncello	8ft.
Trombone	16ft.

The restoration of the church involved the displacement of the organ, and it was found impossible to either reconstruct or even remove the old soundboards, so fragile from age and constant alteration had they become. The touch, also, was very heavy, and the action of inferior quality. It was, therefore, decided to have the instrument entirely overhauled; and with a view to this end Dr. Roberts, the organist, submitted a careful specification of the alterations and additions that he considered necessary to the committee appointed to supervise the church restoration. It was adopted, and the contract was given into the hands of Mr. Abbott, of Leeds. The principal facts relating to the present organ are as follows:

There are large reservoirs in the crypt of the church, with feeders of sufficient capacity, worked by Joy's patent hydraulic engines, which supply wind to other reservoirs within the organ itself, near to the windchests. The soundboards are new, the Great Organ having four, the Swell two, the Choir two, the Solo two, and the Pedal Organ three. The divided pallet is used in all the soundboards, and the pneumatic action is supplied to the Great Organ and its couplers. All the key action, roller-boards, and drawstop action is new. All the *new* pipes are of the best spotted metal, in proportion of 100lb. lead to 112lb. tin.

As much as possible of Snetzler's work was kept, and the stops that remain by this maker are in the list marked by italics.

Compass from C C to A^3 in alt on the manuals, on the pedals from C C C to F.

GREAT ORGAN.

1.	Double open Diapason (wood and metal)	16ft.
2.	Large Open Diapason	8ft.
3.	*Open Diapason*, No. 1	8ft.
4.	*Open Diapason*, No. 2	8ft.
5.	Hohl Flöte	8ft.
6.	*Stopped Diapason* (wood and metal)	8ft.
7.	*Principal*	4ft.
8.	Harmonic Flute	4ft.
9.	*Twelfth*	2ft.
10.	*Fifteenth*	2⅔ft.
11.	*Full Mixture*	III ranks.
12.	*Sharp Mixture*	II ranks.
13.	Posaune	8ft.

SWELL ORGAN.

14. *Bourdon* and *Teneroon* (wood and metal)	16ft.
15. *Open Diapason*	8ft.
16. *Stopped Diapason* (wood and metal)	8ft.
17. *Dulciana*	8ft.
18. Violoncello	8ft.
19. Cone Gamba	8ft.
20. Voix Celeste	8ft.
21. *Principal*	4ft.
22. Gedact Flute	4ft.
23. Piccolo	2ft.
24. Mixture	V ranks.
25. Double Trumpet	16ft.
26. Horn	8ft.
27. *Oboe*	8ft.
28. *Clarion*	4ft.

CHOIR ORGAN.

29. Lieblich Bourdon (wood and metal)	16ft.
30. *Open Diapason*	8ft.
31. Dulciana	8ft.
32. Pierced Gamba	8ft.
33. Flauto Traverso	8ft.
34. Dolce (metal and wood)	8ft.
35. *Stopped Diapason*	8ft.
36. *Stopped Flute* (metal)	4ft.
37. Flauto Traverso	4ft.
38. Bassoon and Clarionet	8ft.

SOLO ORGAN.

39. Gamba	8in. wind	8ft.
40. Harmonic Flute,	8in. ditto	4ft.
41. *Mounted Cornet*,	3in. ditto	V ranks.
42. Orchestral Oboe,	3in. ditto	8ft.
43. Tuba,	8in. ditto	8ft.

PEDAL ORGAN.

44. Double Open Diapason	32ft.
45. Open Diapason	16ft.
46. Violone	16ft.
47. Bourdon	16ft.
48. Violoncello	8ft.
49. Trombone	16ft.

COUPLERS AND ACCESSORIES.

50. Pedal Action.
51. Great to Pedal.
52. Swell to Pedal.
53. Choir to Pedal.
54. Solo to Pedal.
55. Swell to Great.
56. Choir to Great.
57. Solo to Great.
58. Swell to Choir.

Composition Pedals.—Four to act on Great and Pedal Organ, three on Swell; the Couplers, Swell to Great, and Pedals to Great can also be actuated by a pedal as well as the stop handle.

SUMMARY.

	Stops.	Pipes.
Great Organ	13	928
Swell „	15	1095
Choir „	10	568
Solo „	5	370
Pedal „	6	180
Couplers	9	
Total	58	Total 3141

Perhaps the only fault of any moment to be found with the above specification is the poorness of the Pedal Organ in comparison with the other departments. Surely, with such a sum total, one expects to find some 8ft. reeds in the Pedal Organ, and at any rate a Mixture, or even a Great Quint. But it must be remembered that the Mixture would be out of place unless it had to cover reed stops, so that the one involves the other.

One of the most perfect church organs that we boast is that in the Temple Church, recently completely restored and reconstructed by Messrs. Forster and Andrews, of Hull. This instrument has been mentioned in the former part of our treatise as being the one which gained for Smith his notoriety and ascension over his rival, Harris. Smith's original organ consisted of a Great Organ, Choir Organ, and Echo Organ. The latter was removed by Byfield towards the end of the last century, to make room for a Swell. When, about forty years ago, the restoration of the church was determined on, an organ chamber was built for the instrument on the north side of the building, and the organ was added to by Mr. Bishop. In 1877 the benchers arranged that the organ should undergo a thorough restoration, and that there should be made such additions as would place it in the first rank of church organs.

Of the former instrument nothing now remains except the pipes, bellows, and case. We lay the specification before our readers, as one which could with difficulty be equalled. The letters in the centre column refer to the builders who supplied each stop, and may be recognised as follows; A, Smith, 1684; B, Byfield, 1740; C, Bishop, 1842; D, Robson, 1856; E, Schulze, 1862; F, Forster and Andrews, 1878.

The compass of the manuals is from C C to G^3, that of the pedals from C C C to F.

GREAT ORGAN.

1.	Double Diapason (closed)	A D	16ft.
2.	Large Open Diapason	A	8ft.
3.	Small Open Diapason	E F	8ft.
4.	Stopped Diapason	A	8ft.
5.	Hohl Flöte	E	8ft.
6.	Viol di Gamba	E	8ft.
7.	Principal	A	4ft.
8.	Octave	E	4ft.
9.	Nason Flute	A	4ft.
10.	Twelfth	A	2⅔ft.
11.	Fifteenth	A	2ft.
12.	Full Mixture	A	III. ranks.
13.	Sharp Mixture	A F	III. ranks.
14.	Large Trumpet	E	8ft.
15.	Small Trumpet	A	8ft.
16.	Clarion	D	4ft.

SWELL ORGAN.

17.	Bourdon	D	16ft.
18.	Open Diapason	B E	8ft.
19.	Röhr Gedact	A B	8ft.
20.	Salicional	F	8ft.
21.	Voix Celeste	F	8ft.
22.	Principal	B D	4ft.
23.	Röhr Flöte	A	4ft.
24.	Twelfth	A	2⅔ft.
25.	Fifteenth	A	2ft.
26.	Mixture	B D	V. ranks.
27.	Double Bassoon	D	16ft.
28.	Horn	B D	8ft.
29.	Oboe	D	8ft.
30.	Vox Humana	F	8ft.
31.	Clarion	B	4ft.
32.	Spare Slide		

CHOIR ORGAN.

33. Lieblich Bourdon	E	16ft.
34. Violin Diapason	E	8ft.
35. Lieblich Gedact	E	8ft.
36. Spitz Flöte	A	8ft.
37. Dulciana	C	8ft.
38. Flaute Traverso	E	8ft.
39. Gemshorn	A	4ft.
40. Violino	E	4ft.
41. Lieblich-flöte	E	4ft.
42. Mixture	D E	III. ranks.
43. Corno di Basseto	C D	8ft.

SOLO ORGAN.

44. Flute Harmonic	F	8ft.
45. Flute Octaviante	F	2ft.
46. Piccolo Harmonic	F	2ft.
47. Tuba	F	8ft.
48. Clarionet	F	8ft.
49. Orchestral Oboe	F	4ft.

PEDAL ORGAN.

50. Sub Bass	D	32ft.
51. Major Bass	D F	16ft.
52. Open Bass	F	16ft.
53. Viola	E	16ft.
54. Stopped Bass	D	16ft.
55. Quint	D	10⅔ft.
56. Violoncello	E	8ft.
57. Principal (Slide)		8ft.
58. Twelfth	D	5⅓ft.
59. Fifteenth	D	4ft.
60. Trombone	F	16ft.

COUPLERS, &c.

1. Swell to Great
2. Swell to Choir
3. Choir, Sub-octave to Great
4. Solo to Great
5. Great to Pedals
6. Swell to Pedals
7. Choir to Pedals
8. Solo to Pedals
9. Pedal Octave
10. Tremulant to Swell

ACCESSORY MOVEMENTS, &c.

Five composition pedals to Great, three to Swell, and one pedal for soft Pedal Organ.

1. Draws 5, 6, 53, 54.
2. Draws 2, 4, 52, 53, 54.
3. Draws, 2 3, 4, 6, 7, 8, 9, 50, 51, 52, 53, 54, 56.
4. Draws the above stops together with 10, 11, 12, and 55, 58, and 59.
5. Full Great with Full Pedal.
6. Draws 18, 19, 20.
7. The same with 17, 22, 23, 24, 25, 29.
8. Full Swell.
9. Soft Pedal 51, 52, 53, 54.

Pedal to draw on and off Swell to Great; Pedal to draw on and off Great to Pedals; Tremulant by Pedal.

Having disposed of church organs, we next take into consideration the still larger form of hall instrument; and it is to be remembered that no public hall can be looked upon as perfect if it does not contain an organ capable of taking its proper part in oratorio, if not, indeed, worthy of the very popular recitals that are now so frequently given in almost every town of consequence.

Of course, it would be useless to put a small organ in such a building; and, as we have referred to the two-manual instrument that is in the Bow and Bromley Institute, we cannot do better than cite a perfect specimen in that of the organ in the Public Hall, Glasgow. This instrument was built by Messrs. T. C. Lewis and Co., under the direction and from the plans of Messrs. W. T. Best and H. Smart; it contains four manuals and pedals as follows:

GREAT ORGAN.

*1.	Double Open Diapason	16ft.
*2.	Open Diapason (large)	8ft.
*3.	Open Diapason (small)	8ft.
*4.	Röhr Flöte	8ft.
*5.	Octave	4ft.
*6.	Twelfth	2⅔ft.
*7.	Fifteenth	2ft.
*8.	Sexquialtera	IV. ranks.
*9.	Trumpet	8ft.
†10.	Bourdon	16ft.
†11.	Viola	8ft.
†12.	Hohl Flöte	8ft.
†13.	Harmonic Flute	4ft.
†14.	Octave Viola	4ft.
†15.	Mixture	V ranks.
†16.	Double Trumpet	16ft.
†17.	Trombone	8ft.
†18.	Clarion	4ft.

* Front Great Organ. † Back Great Organ.

SWELL ORGAN.

1.	Bourdon	16ft.
2.	Open Diapason	8ft.
3.	Spitz Flöte	8ft.
4.	Viol di Gamba	8ft.
5.	Voix Celeste	8ft.
6.	Flauto Dolce	8ft.
7.	Octave	4ft.
8.	Swabe Flute	4ft.
9.	Nazard	2⅔ft.
10.	Fifteenth	2ft.
11.	Full mixture	IV ranks.
12.	Echo Dulciana Cornet	VI ranks.
13.	Contra Fagotto	16ft.
14.	Trumpet	8ft.
15.	Cornopean	8ft.
16.	Oboe	8ft.
17.	Clarion	4ft.

SOLO ORGAN.

*1.	Tuba	8ft.
*2.	Tromba	8ft.
*3.	Harmonic Flute	8ft.
*4.	Octave Flute	4ft.
*5.	Cor Anglais	8ft.
*6.	Oboe	8ft.
*7.	Clarionet	8ft.

* Enclosed in a Swell box.

CHOIR ORGAN.

1.	Lieblich Bourdon	16ft.
2.	Violin Diapason	8ft.
3.	Dulciana	8ft.
4.	Flauto Traverso	8ft.
5.	Lieblich Gedact	8ft.
6.	Lieblich Flute	4ft.
7.	Gemshorn	4ft.
8.	Piccolo	2ft.
*9.	Vox Humana	8ft.
*10.	Clarionet	8ft.

* Enclosed in a Swell box.

PEDAL ORGAN.

1. Double Open Diapason	32ft.
2. Open Diapason (wood)	16ft.
3. Open Diapason (metal)	16ft.
4. Violin Dulciana	16ft.
5. Quint	10⅔ft.
6. Octave	8ft.
7. Violoncello	8ft.
8. Grave Mixture	II. ranks.
9. Trombone	16ft.
10. Contra Fagotto	16ft.
11. Trumpet	8ft.
12. Clarion	4ft.

COUPLERS.

1. Full Pedal Organ
2. Great to Pedals (also a pedal left side.)
3. Choir to Pedals (also a pedal right side).
4. Swell to Pedals (also a pedal right side).
5. Solo to Pedal (also a pedal left side).
6. Swell to Great, Sub Octave.
7. Swell to Great Unison.
8. Swell to Great, Super Octave.
9. Choir to Great.
10. Swell to Choir.
11. Solo to Great.
12. Great to Solo.
13. Solo, Sub Octave on Self.
14. Solo, Super Octave on Self.

ACCESSORY MOVEMENTS.

Three composition pedals to Swell, four composition pedals to Great and Pedal; Ventil pedal admits wind to back Great Organ, Swell Crescendo pedal, Solo Crescendo pedal, Choir Crescendo pedal, Tremulant to Choir, Tremulant to Swell.

Compass of manuals from C C to C^4 pedals C C C to F.

Perhaps we are not going too far in saying that the organ in the Albert Hall, Kensington, is as complete an instrument as can well be imagined. There may be organs—indeed, there *are* some few—that are as large, but the whole work, having regard to mechanical appliances, judicious arrangement, and compactness, is probably unequalled. The instrument was built by Mr. Willis, and the following description will give a general idea of the care with which the work was planned and carried out.

In the basement under the organ are six large feeders, which supply the various reservoirs in the organ above. These feeders are placed, three above and three below a three-throw crank shaft by which they are worked, each with a movement or stroke of 16in. The crank shaft is driven by a horizontal steam engine of thirteen-horse power, having two cylinders of 7in. diameter and 22in. stroke, regulated by an ordinary governor and throttle valve; an independent throttle valve is worked from the wind reservoirs in the organ, so that the engines are caused to run faster or slower, to stop and start again automatically, according to the consumption of wind by the organ. The three upper feeders above mentioned supply 4in. wind, and the three lower 4in. exhaust. There are also two blowing cylinders, each of 24in. diameter and 24in. stroke, with inlet and delivery valves of indiarubber. Like those of an ordinary blowing engine, these cylinders in the up stroke exhaust air from one reservoir and deliver it in the downstroke into a high-pressure reservoir. These blowing cylinders are worked by two beam engines, each having a cylinder of 7in. diameter and 24in. stroke, and regulated by an ordinary governor and throttle valve. Two special throttle valves are connected, one with the pressure, and the other with the exhaust reservoir, so that whenever a pressure *and* an exhaust of 24in. is attained, both valves are shut.

The pressure and exhaust are chiefly for reciprocating mechanical purposes, such as moving slides, &c. The annexed sketch will explain the principle, though not the actual constructive arrangement, by which these are effected.

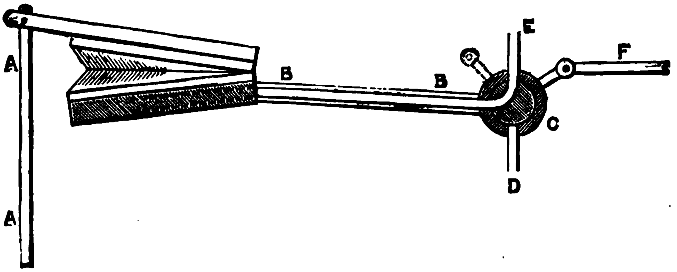

FIG. 71. PRINCIPLE OF PRESSURE AND EXHAUST.

AA.	Connecting rod to slide.
BB.	Tube transmitting pressure or exhaust (any distance).
C.	Arrangement similar to ordinary cock or tap.
D.	Tube leading to exhaust chamber.
E.	Tube leading to pressure chamber.
F.	Connecting rod to drawknob.

The means whereby the immense Pedal Organ is worked are specially contrived for the instrument. Near to the pedal keys is placed a series of what may best be termed soundboards, with grooves, slides, and upper boards, as usual, but these soundboards are much smaller than would be required were the pipes placed upon them; and from the holes in which the pipes would ordinarily stand proceed conveyance tubes, one for each pipe, to a series of pneumatic levers placed adjacent to the large soundboards, in different parts of the instrument, on which the pipes actually stand. The pallets in the small soundboards acted upon by the pedal keys thus become the valves of the pneumatic levers, and admit air or allow it to escape from them when the keys are played upon. Each pneumatic lever works a pallet or valve, which admits the wind contained in the chest of the large or actual soundboard to one of the pipes.

The four-manual organs are all played by pneumatic action. The

Great Organ is placed in the centre, and behind it, recessed beyond the outer wall of the building, is the Swell Organ. The Choir Organ is on the right, and the Solo Organ on the left side. Each of these four manual organs is built, as it were, in two stories, the flue work on a lower, and the reed work on an upper soundboard. The Pedal Organ also is divided into three sections, the centre portion containing the 16ft. metal Open Diapason, the 16ft. metal Violone, the Bourdon and Octave, and some other stops, arranged so as to screen the swell louvres. Below this centre section is the pedal reed work. The right and left divisions contain, amongst other stops, the 16ft. and 32ft. Open Diapasons of wood, with the exception of a few lower notes of the latter.

In the organ front appear the metal Double Open Diapason and Contra Violone 32ft., furnishing pipes for the two towers and their supports, as well as those over the arches. The pipes over the central arch are from the great Contra Gamba. The inside pipes of this and other stops which contribute to the front are similarly shaped in mouth, body, and foot.

All the pipes in the Choir Organ are of metal, the effect of wood being imparted by careful voicing and harmonic construction. The Choir stops that in the list are numbered respectively 1, 3, 6, 8, 9, 11, 14, and 17 represent what is called the Echo Organ, which in some instruments has been placed on a separate manual. In the Great Organ only the bass of the Bourdon and Claribel are of wood; and in the Swell Organ the basses of the Bourdon and Claribel Flute are of this material.

Nos. 11, 12, 13, 14, and 17 of the Solo Organ are in a swell box.

The internal metal pipes are composed of five-ninths lamb stamp commercial tin to four-ninths of soft lead, whereas the show pipes are 90 per cent. pure tin, and are polished and varnished. The scales of the pipes are suited to the proportions of the building, and the entire workmanship has been carried out in the very best style. The key fittings are elegant in design, and the keys themselves of extra thick ivory. The combination pistons are plated with gold and engine turned.

The following is a list of stops, &c.:

Compass on manuals from C C to C^4, on pedals from C C C to G.

GREAT ORGAN.

1.	Flute Conique (partly harmonic)	16ft.
2.	Contra Gamba	16ft.
3.	Violone	16ft.
4.	Bourdon	16ft.
5.	Open Diapason	8ft.
6.	Open Diapason	8ft.
7.	Viol di Gamba	8ft.
8.	Claribel	8ft.
9.	Flute Harmonique	8ft.
10.	Flute à Pavillon	8ft.
11.	Quint	5⅓ft.
12.	Flute Octaviente Harmonique	4ft.

GREAT ORGAN (*continued*).

13.	Viola	4ft.
14.	Octave	4ft.
15.	Quint Octaviente	2⅔ft.
16.	Piccolo Harmonique	2ft.
17.	Super Octave	2ft.
18.	Furniture	V ranks.
19.	Mixture	V ranks.
20.	Contra Posaune	16ft.
21.	Posaune	8ft.
22.	Trompette Harmonique	16ft. and 8ft.
23.	Tromba	8ft.
24.	Clarion Harmonique	8ft. and 4ft.
25.	Clarion	4ft.

SOLO ORGAN.

1.	Contra Basso	16ft.
2.	Flute à Pavillon	8ft.
3.	Viola d'Amour	8ft.
4.	Flute Harmonique	8ft.
5.	Claribel Flute	8ft.
6.	Voix Celeste	8ft.
7.	Flauto Traverso	4ft.
8.	Concert Flute	4ft.
9.	Piccolo Harmonique	2ft.
10.	Cymbale	
11.	Corno di Bassetto	16ft.
12.	Clarionet	8ft.
13.	Bassoon	8ft.
14.	French Horn	8ft.
15.	Ophicleide	8ft.
16.	Trombone	8ft.
17.	Oboe	8ft.
18.	Bombardon	16ft.
19.	Tuba Mirabilis	8ft.
20.	Tuba Clarion	4ft.

SWELL ORGAN.

1.	Double Diapason	16ft.
2.	Bourdon	16ft.
3.	Salicional	8ft.
4.	Open Diapason	8ft.
5.	Viol di Gamba	8ft.
6.	Flute à Cheminée	8ft.
7.	Claribel Flute	8ft.
8.	Quint	5⅓ft.
9.	Flute Harmonique	4ft.
10.	Viola	4ft.
11.	Principal	4ft.
12.	Quint Octaviente	2⅔ft.
13.	Super Octave	2ft.
14.	Piccolo Harmonique	2ft.
15.	Sesquialtera	V. ranks.
16.	Mixture	V. ranks.
17.	Contra Posaune	16ft.
18.	Contra Oboe	16ft.
19.	Baryton	16ft.
20.	Vox Humana	8ft.
21.	Oboe	8ft.
22.	Cornopean	8ft.
23.	Tuba Major	8ft.
24.	Tuba	4ft.
25.	Clarion	4ft.

CHOIR ORGAN.

1.	Violone	16ft.
2.	Viol di Gamba	8ft.
3.	Dulciana	8ft.
4.	Lieblich Gedact	8ft.
5.	Open Diapason	8ft.
6.	Vox Angelica	8ft.
7.	Principal Harmonique	4ft.
8.	Gemshorn	4ft.
9.	Lieblich Flute	4ft.
10.	Celestiana	4ft.

CHOIR ORGAN (*continued*).

11. Flageolet	2ft.
12. Piccolo Harmonique	2ft.
13. Super Octave	2ft.
14. Mixture	III. ranks.
15. Corno di Bassetto	16ft.
16. Clarionet	8ft.
17. Cor Anglais	8ft.
18. Oboe	8ft.
19. Trompette Harmonique	16ft. and 8ft.
20. Clarion	4ft.

PEDAL ORGAN.

1. Double Open Diapason (wood)	32ft.
2. Double Open Diapason (metal)	32ft.
3. Contra Violone (metal)	32ft.
4. Open Diapason (wood)	16ft.
5. Open Diapason (metal)	16ft.
6. Bourdon (wood)	16ft.
7. Violone (metal)	16ft.
8. Great Quint (metal)	10⅔ft.
9. Violoncello (metal)	8ft.
10. Octave (wood)	8ft.
11. Quint (metal)	5⅓ft.
12. Super Octave (metal)	4ft.
13. Furniture	V ranks.
14. Mixture	III ranks.
15. Contra Posaune (wood)	32ft.
16. Contra Fagotto (wood)	16ft.
17. Bombarde (metal)	16ft.
18. Ophicleide (wood)	16ft.
19. Trombone (metal)	16ft.
20. Fagotto (wood)	8ft.
21. Clarion (metal)	8ft.

COUPLERS, &c.

1. Solo Sub-Octave on Self.
2. Solo Super-Octave on Self.
3. Swell Sub-Octave on Self.
4. Swell Super-Octave on Self.
5. Solo to Great.
6. Swell to Great.
7. Choir to Great.
8. Swell to Choir.
9. Solo to Choir.
10. Solo to Pedals.
11. Swell to Pedals.
12. Great to Pedals.
13. Choir to Pedals.
14. Sforzando.

ACCESSORY MOVEMENTS, &c.

A double acting vertical movement, struck by the heel of either foot, detaches or connects the action of the Pedal Organ from or with all but the Bourdon, Violone, Open Diapason metal, and Octave, and at the same time draws or puts in the coupler Great to Pedal.

There are eight patent pneumatic combination pistons to each of the manual organs, governing the whole of its stops. These are arranged immediately below and in front of each manual, concentrated for convenience of access.

Six combination pedals govern the stops of the Pedal Organ. A pedal brings into action a movement which causes these six combination pedals just mentioned to act also on the combination movements of Great Organ. Another pedal takes this last movement off. Six pedals govern and combine all the foregoing accessory movements, thus varying the effect of the whole instrument at one operation.

Tremulant by pedal to suitable stops of the Swell Organ.

Tremulant by pedal to suitable stops of Solo Organ.

Sforzando Pedal.

A pedal drawing coupler "Great to Pedal."

A pedal reversing the above.

A patent atmospheric contrivance is applied for acting on the Swell louvres, by which means the shutters can be instantly opened or closed, independently of the Swell Pedal.

CHAPTER XXIX.

General Arrangement of Parts.

There is much to be said with regard to the arrangement of the many parts of an organ that could not come under any particular heading, as of organs themselves, but which is nevertheless of too great importance to be missed or passed lightly over, and although sufficient has been written relating to the position of each portion of the instrument when considering them individually, there yet remain to be considered some questions which arise when these separate portions are placed together in the case of the instrument.

With respect to the interior arrangement of the mechanism and pipes of an organ, a great deal will depend upon (*a*) local circumstances, such as room, &c.; (*b*) the system which has been adopted in the mechanism, whether it be of the tonal, semi-tonal, or Vogler's principle; (*c*) the size of the instrument.

It may be noticed that we have not said much relating to organ cases. The fact is that the formation of an organ case is scarcely a matter for separate consideration. There is little to be said of it; indeed, a case in the old sense of the word is almost obsolete. What is now termed the organ case is really a most important portion of the instrument itself. Formerly, the pipes and mechanism were placed in a box or an artificial covering, ornamented or not, according to local option, but, as far as music was concerned, utterly unconnected with the instrument. Now, as will have been gathered from the previous chapters, the case has come to mean certain parts of the organ itself. The pipes that are in sight—*i.e.*, the show pipes—are of the case; and, then, the instrument has been adapted not only with a view of producing a certain amount of *sound*, but that it may at the same time qualify that tone by its own inherent construction; hence room has been more or less allowed for pipes. They have been placed, to some extent, external to the mechanism, and perhaps only a few more or less ornamental binding beams of a light character appear anywhere save at the lower portion of the instrument. With regard to the decoration of this so-called case, surely that is a matter which depends so entirely upon local surroundings that it is almost needless, not to say impossible, to offer any useful or apposite remarks on the subject. The best advice under the circumstances is to say of the case what one would say of the organ itself. Go to a person whose business it is to understand the art of decoration, and, if he has a reputation, there is little fear of serious error. Leave the matter to a local vestry of well-meaning busybodies, or to an enthusiast, and the probability is that glaring mistakes will be perpetrated. If the organ itself is built in accordance with rules, hard and fast in the matter of sound passages, &c., the only question that can occur as to case will be that of decoration. Here, then, we leave the subject, not suggesting that it is in any way secondary, for it is not, but asserting that the very plan of the instrument must involve a case, and that therefore it may be said to evolve itself as the work is planned.

Were it not that experience teaches us otherwise, it would seem impertinent to suggest that the first item with regard to the erection of an organ is that the foundation for its reception be firm. Unfortunately, an instrument is frequently placed upon a platform or erection which is incapable of bearing the great weight imposed upon it without "giving." The effect on the organ is, of course, most disastrous, for under such circumstances the mechanism has not even a remote chance of remaining unstrained. By the giving of the flooring, all the delicate movements are more or less strained, and even if the pipes themselves do not immediately show signs of displacement, ciphering, sticking, &c., a want of answer to the touch is the inevitable consequence. More especially does this danger become prominent when an organ is built in a public hall or concert room, for although the platform on which the instrument stands may be ample for its own support, yet when the additional weight of a large choir of, say, some hundreds of voices, is stationed upon the structure, then a strain is imposed that should be carefully foreseen in its erection. Some organs have been known to suffer in this way so seriously as to put them quite out of the question when a gigantic choir was to be used in the building.

The pipework of every organ should not only have "room enough," but more than is actually required for the proper speaking of the pipes themselves. Therefore, large soundboards are a great consideration; not only if these are of sufficient size can each pipe speak properly, but the arrangement of the pipes can be such as to prevent any extra conveyancing; and it is obvious that a pipe can speak better over its wind than in any other position. Not only so, but room in an organ is not lost because it is not actually filled by some piece of mechanism. Roomy passage boards are a necessity as well for tuning as for other purposes, but they serve another great purpose, viz., they give room for the sound of the pipes to speak. And here we do not mean the mere sounding of the proper note of each pipe, but any spare room in an instrument affords, as it were, a kind of accumulating power to the sounds, so that, instead of becoming a mere jumble, they assume that proper combination desired, and emerge from the instrument in a clear and perspicuous form. Within reason, an organ cannot be too empty for its size, and there can be no doubt whatever that many small organs owe the reputation they have attained to the fact that what stops they have are allowed sufficient room to bring out the body of their tone in a fully matured current.

With regard to the way in which the several departments of a large organ are disposed, that, again, is a matter depending upon local circumstances, and in any case a competent builder will be able to give sound advice upon the matter. Roughly speaking, if there is room enough to do as you like, perhaps, for a four manual instrument, the following arrangement would be best: Have the Great Organ well up, *i.e.*, so far above the player as to allow the sound thereof to be carried over his head, and not sent about his ears. Then if the Swell Organ is placed *above* that again, and the pipes of the Great Organ are allowed good space between them and the bottom of the Swell, it will be found that the sound of the former will be forced out into the building, much in the same manner as was the voice of a preacher when he was placed in a pulpit having the old-fashioned canopy or sounding-board over his head. The Choir Organ should be on a level with the Great, either in front or behind it, though, perhaps, the latter is the better position. A Solo Organ may be arranged according to circumstances, either at the side, in front, or above the Great Organ. The Pedal Organ is generally more or less dispersed, and can be placed at the side of the instrument, and some of the larger pipes—indeed sometimes the whole department—are put entirely behind the rest of the organ.

It is not necessary to go into detail as to the position of the stops themselves, or as to what stops should constitute show pipes—these matters will be based upon individual and local peculiarities. Of course the stops should be so arranged on their respective soundboards that the larger pipes are behind the smaller, so that the sound of any and every stop may penetrate into the building without interfering with that of any neighbours.

It would hardly be appropriate here to enter into the position assumed by each mechanical portion of an organ, but there are certain rules to be remembered that will give a general idea of the way in which all matters of this kind should be arranged.

All mechanism should be so contrived that it can be got at with the greatest ease, whereby an organist can at once put a trifling sticking, or the like, into order without having either to disturb a service or concert, or, worse still, wait for a builder. Then, with regard to roller boards, &c., their very existence will depend upon the system adopted; but should they be present, they should be so placed as to exclude as little light as possible from the interior of the instrument. The mechanical portion of modern organs is, as far as practicable, constructed of iron, and is made of a character to take up little space and to make as little noise as possible; but the trackers, buttons, &c., that are inevitable, should be so placed that any little irregularity can be at once detected and attainable by the organist.

That the mechanism should be of the best, that the parts in themselves should be solid, that the swell-box should be of sufficient thickness, that the pipe material should be good—in fact, that the organ should be a work of high art throughout, depends entirely upon the way in which its building is undertaken. There are so many eminent builders in this country, as well as on the Continent, that there is little fear of inability to get a competent artist, and the question really resolves itself into one of "price."

After all, how much may be laid to the door of that little word "price?" If money were no factor in the building of an organ, if any generous aspiring individuals gave any of our great firms *carte blanche* to build an instrument suitable to such and such a building, how little fear need there be of the result. But it unfortunately happens that organ builders have not only their art to consider, but also their commercial relationships. In other words, they have not only to build beautiful or other instruments, but also to live in this age of competition, so that it happens, as a natural result, that there are organ builders *and* organ builders. That there are many men who are artists in their calling we cannot doubt, but even the very highest in this branch of art—for art it is—have to succumb to the inevitable demand for cheap instruments. When the organ was only a luxury, and appeared only in this great Cathedral or in that nobleman's hall, the builders were few and far between. They were despotic and mighty artists, who would have this and that in their instruments, who would have this sum and that sum, and who took more time in the making of what we should call a village instrument than would be occupied by any of our great firms in building a "four-decker" for a concert hall. Smith had £1000 for the organ in the Temple, and £500 extra for the case, and it was not larger than many a village or small parish organ when he left it. It is only fair to say that we have known, and know, more than one instance of builders who have remained poor, or, at any rate, have never attained riches, because they were always loth to erect an instrument without expending thereon the utmost that was possible in the matter of labour and material under the circumstances of the contract; whereas, had they merely looked upon the affair as an ordinary trade transaction, they might without any fear of detection have saved many a pound.

It does not require demonstration to see how easily the uninitiated may be trapped into what they think is a good bargain with regard to organs. Supposing that it is decided to erect an organ in, say, a parish church. Neither the clergyman nor the churchwardens, nor, perhaps, for that matter, anyone in the neighbourhood, are learned in matters appertaining to organ building. But the organist, we will suppose, has an accumulation of experience which amounts to the fact that "the more stops the better"! It is decided to receive tenders for the supply of the instrument, much as they would for the supply of coals for the parish charities. We will suppose that the sum to be expended is £1000. One builder sends in a specification for an instrument of twenty-five stops. We need not enumerate the list. He says something about material, wind pressure, and the like, and leaves the matter to their judgment. Another builder, living within a mile of the former applicant, sends in a paper setting forth that he will, if the contract be given him, build an instrument of forty stops, with this arrangement, with that convenience, with a Tremulant action, with a Vox Humana, with, in fact, everything that a large organ should have. Between these two extremes we will suppose several more or less fair specifications, but the chances are that our friend of the "forty stops" gets the work—his job he would call it. They get their organ built, and it is opened with great display by the organist of the county cathedral, and everything is perfectly satisfactory—more than satisfactory. Some few weeks after the erection of the instrument stickings and cipherings occur during a service, and it is noticed that the reeds and some other stops are much out of tune. But these little defects are put down to the fact that the organ, being so very new, is hardly seasoned to its position. The builder (this first time) readily comes over, and once more the instrument is in its pristine glory. After some little acquaintance, even the organist himself admits that his organ is hardly so perfect as a smaller one of the neighbourhood, and that there is a roughness in this or that stop, but he says that all will come right when time has mellowed the instrument.

To make a long story short, the real matter is this—instead of having an organ worthy the name, we have here a mere collection of imperfect mechanism and pipes, to make a certain sound, to "come up to the scratch" (if we may use the expression) for the opening festival, and to secure to our cheap builder a contract he desired. He got precisely the same profit as would his brother craftsman who proposed the smaller instrument—then how did he accomplish his task? Instead of having reliable foundation stops, of solid material and good metal and going throughout, he substitutes poor thin work, grooves many stops into the bass octaves of perhaps an Open Diapason and a Stopped Diapason, that have, with the smaller flue stops, to do pretty well all the bass work. He has a multitude of small unimportant stops of four and even two feet length, that look important on the draw-knobs, and there only. He utterly scamps the pedal work, where he places Couplers and Stopped Doubles, thin scales, and everything and anything to actually lessen the real bread-and-cheese quality of the instrument. The mechanical parts throughout are roughly put together, and the trackers and woodwork generally are unseasoned and of bad quality. The reeds are rough and uncouth; and probably they, if not the whole metal work of the organ, were procured wholesale as a "lot" from some individual who is always prepared to "supply all requisites for organs of any size."

This is by no means an overdrawn picture; but what of the other side? If the supposed buyers in this case had chosen the builder who offered apparently less, what would they have had? An organ that was a work of art throughout; an instrument that was perfect as far as it went, and of which they might have been proud for many a year to come; good solid and complete stops, metal pipes that would have gladdened the eyes, and of course the ears, of any stray *connoisseur* who happened that way; perfect mechanism, and in the end, instead of having continually to send for assistance to rectify the shortcomings of a wheezy box of whistles, they would have been proud of the tone and character of an instrument that would have cost them next to nothing to keep in perfect order.

It seems almost useless to enumerate the many ways in which this difference of apparent value can be brought under any given price. Weight of metal, time for good workmanship, incomplete stops, bad general finish, want of delicacy in voicing, and all and every separate portion of an instrument can lend aid to cheapen a bad or enhance the value of a good instrument. It is, of course, not possible to mention names in this manual; but it is, perhaps, fair to state that we wot of a certain firm who have so stringently refused to build any but the best instruments, be they never so small, that organists, and those who are interested in the subject, always know when they hear of an instrument bearing this name that it is up to a standard that needs no inquiry. The instruments are very costly, but not expensive; and, though many may hold that there may be improvements to be suggested in some matters, none hint that the work is not of the most thorough character.

Perhaps one of the most prominent faults that often occurs is the sounding of a pipe when under the circumstances it should remain silent. This is termed "ciphering," and may arise from various causes. A pipe does not necessarily speak its full tone when it "ciphers," but may give a hissing noise, or a more or less distinct note. The following are some of the chief causes :

CIPHERING.

Pull-down.—This may be rusty and stick in the brass plate through which it communicates with the pallet. The remedy is to scour the "pulldown" wire with glass paper, but in doing so carefully avoid straining or bending it.

Pallet.—By accident, some bit of dirt or grit may slip down through the "table" and lodge between the face of the pallet and the groove on which it should bed, in which case the pallet would be kept slightly open and the pipe would cipher. To remove this, it is necessary to take off the front board of the wind chest and carefully wipe the pallet and also the groove above it.

Pallet-spring.—This may be so weak as not to allow the pallet to bed close to the soundboard groove, and can be altered by adding a check spring outside the wind chest to the action of the pallet in question. Of course, the real remedy is to replace the weak pallet-spring by another of sufficient power.

Pallet Leather.—If the atmospheric changes have been sufficient to affect the leather covering a pallet, this may warp and bulge up, and then it will be necessary to remove the pallet altogether and re-cover it. Under aggravated circumstances the pallet itself may warp, but in case such an event occurs it is wise not to attempt its correction unless thoroughly *au fait* at organ work.

Pallet Catching.—Sometimes a pallet may catch in one of the pins placed to guide it; this is easily altered by releasing the pallet.

Keys.—Any warping of keys themselves, or of the key movement generally, will cause a ciphering. If the keys themselves have swelled and bound, it will be necessary to remove the offending members and scrape them, &c. We do not give in detail the course to be followed to remove keys, but merely draw attention to the fact that ciphering is caused by their sticking. It should be mentioned that "dirt" is a frequent source of ciphering. It is allowed to accumulate between the keys until it impedes their action.

Stickers.—Damp will frequently cause a sticker to bind in the hole of the register through which it should pass, in which case a little scraping will put the matter right. Sometimes the blacklead requires renewing.

Backfalls very often slip out of gear with the sticker-pins; this would naturally cause some displacement of the mechanism of the key, and so bring about a ciphering. It is then only necessary to replace them in their original position.

Soundboard.—By far the most harassing ciphering that can occur is that which may be due to any condition of the soundboard or its immediate surroundings. For instance, if a soundboard bar becomes separated from the table, then a little wind will escape into the next groove, and the result is a humming, or a distinct speaking of the pipe over the latter, according to the amount of wind which may be escaping through the aperture. It may happen that the upper board is not properly screwed down, and in that case it will only be necessary to see that the screws in the neighbourhood of the ciphering pipe be tightened. If the ciphering should not cease, it will be found probably due to the leakage from one groove to another. This can be ascertained by noting the sound of the ciphering pipe, and comparing it to the arrangement of the pipes, *i.e.*, if the pipes are placed semitonally, and the sound is either a semitone above or below that of the pipe the key of which is pressed when the ciphering occurs, then the error is owing to the leaking of a groove. When it *is* due to this latter state of affairs, the remedy is to glue paper over the offending bar, so as to stop the leak. But we should strongly advise none but experienced hands to attempt to meddle with the soundboard of a good organ, so that if all other tests fail, and such a serious catastrophe is apprehended, it would be better to consult a builder at once.

Sliders.—A ciphering may sometimes be due to the touching or half drawing of a slider when another slider is moved. This would entail a ciphering when almost any key of the manual was pressed. The remedy is easy, and the most convenient will occur to the discoverer of the evil, according to the circumstances of his particular case.

Crowding of Pipes.—This may sometimes be a source of slight ciphering. If the wind from the mouth of one pipe impinges on to the lips of another, such a result would follow. The cure for this is to alter the positions of the mouths of the pipes; or, better still, to have a new and sufficiently large soundboard.

It will be noticed that we have not said anything here with regard to the habit known to builders as "bleeding" (*ante* p. 55). This is an operation that is performed when a ciphering is caused by a leakage from one groove into another. It consists in letting out sufficient wind from the groove from which the wind is forced, to take off the pressure, so that the air then has no power to penetrate the little chink through which it would pass. The practice is certainly a remedy in some cases, but it is only a clumsy makeshift, and should be avoided under all circumstances.

IMPERFECT SPEECH OF PIPES.

Faltering or Weak Speech of Pipes.—The lesser flue pipes of an organ are very susceptible to dust, and the smallest fragment of dirt, that would not affect a large pipe, may be sufficient to stop entirely the speech of a small one, or if the speech be not quite prevented, it may be weak or tremulous It this should occur in only one or two pipes, they may be taken put and carefully dusted in the region of the mouth and languid, and replaced. If, on the other hand, the whole of the smaller work of the organ suffers in this way, it would be better to give the instrument a complete overhauling and cleaning throughout.

Imperfect Speech of Reed Pipes.—Reed pipes are often a source of anxiety to the organist, and for some cause or other they will become dumb, or will sound some note utterly foreign to their usual intonation. Here again dust very often lodges between the tongue and the reed, the most minute atom of matter in this position being enough to put the largest pipe out of order. Sometimes the tongue becomes slightly corroded, and then it should be removed and most carefully cleaned with some soft substance, great care being taken not to alter its shape in the slightest degree. If after careful manipulation the reed still refuses to speak, and if tapping the tuning wire somewhat sharply refuses to bring the pipe into action, it would be well to call in the aid of some experienced workman.

Although we fully see the advantages of being able to make a pipe, either flue or reed, speak its proper note when it may have been somewhat deranged, yet we must warn our readers that in no case should the pipes of an organ, more especially the reeds, be meddled with if it can be possibly avoided. The speech of a pipe is a most delicate matter, and the smaller the pipe, the more accurate must the speaking parts be, so that any rough handling may necessitate the revoicing, or the absolute renewal of a pipe.

A Pipe Speaking its Octave.—Very often a pipe is found to be speaking the octave above its proper note, and this may happen to several at once, from no apparent cause. All small scale or delicate toned stops, and all heavy stops, such as Gambas, are subject to this condition of things. Perhaps the best known instance that may be experienced in an instrument of almost any size is that of the Dulciana. The fault is occasioned by the accumulation of dust in the mouth of the pipe, by an insufficient, or, more frequently, an undue supply of wind. The remedy will, of course, depend upon the cause, and it is more often a task to discover the actual cause that puts these delicate pipes off their speech than it is to rectify the matter when it *is* found. If dust be the offending presence, its removal will not be difficult. If it be that the wind supply is too full, pressing the lower lip a little inwards may give the desired result. If, on the other hand, the wind is too weak, the reverse action must be followed. In all cases the greatest care must be taken not to mutilate the very tender mouths of these pipes. A change of temperature is sufficient to cause a small scale and thin Dulciana to become faulty in some of its pipes, so that it is not desirable to at once attempt to alter the error until it is found to be more or less permanent.

Faults in Wood Pipes.—Change of temperature is the great cause of all the derangements of the wooden pipes of an organ. When the atmosphere is more or less damp, the pores of the wood become stopped and closed, the structure swells, the mouth of the pipe is less high, and the tendency is that it should speak sharp. When the air is very dry, the pores of the wood are more open, the contraction that always occurs during heat makes the mouth higher than usual, and the tendency would be that the pipe should speak flat.

Stopped Pipes.—With regard to stopped pipes, the same theory holds good, but the stoppers themselves are often a source of faultiness. These may slip down into the pipe, and thus cause an alteration in the pitch, or they may become loose, and in this way be useless. The way to adjust a faulty stopper is to see that it fits the pipe into which it should go, tightly and firmly, but not so tight as to cause any undue strain on the joints of the pipe. If this latter precaution is not taken, the joints of the pipe's sides would start, and the speech of the pipe become entirely ruined. When the leather surrounding a stopper is too thin, a new piece should be substituted, or a bit of brown paper properly secured over the old leather. Stoppers should never be left in a pipe in any save a horizontal position. When they are allowed to be sideways or uneven, they cause a faulty tone.

Defects of Wind.

Faults in Bellows.—There are one or two faults that may occur in the action of bellows that can be remedied without any serious risk. The first, perhaps, that will happen in an organ is a creaking noise at one of the joints of the bellows action; this can be stopped at once by a little grease. Although this is a very simple matter indeed, we have known instances where this unpleasant noise has been allowed to continue for months, to the detriment of every performance on the organ.

Valves.—The valves of the bellows are often a source of some fault. A gasping sound may be heard when they are too few or too small. A sort of loud tapping sound is apparent when they are too hard and go down with a snap. This last fault may be altered by covering the valves with more leather, but when the gasping is heard it means that the valves are either too small, or are not sufficiently numerous to admit a requisite amount of wind for the instrument. This must be at once attended to, and can only be properly and permanently remedied by the addition of more valves. In hot seasons it will be noticed that the bellows require more filling than during cold. This is owing to the curling of the valves, or the general contraction of the wood of the ribs, &c. If this should not go off when the colder period arrives, the bellows must be thoroughly overhauled and properly balanced to supply the instrument they are attached to.

Short Wind.—There are many causes that may be mentioned that will contribute to the tremulousness that is often heard in organs. If a passage be played in the treble, and pedal or bass passage added *staccato*, then it is found that the pipes, instead of giving a pure even speech, are more or less jerky. This may arise from insufficiency of wind itself, in which case new bellows should be obtained. A jerkiness may also be caused by a lengthy and small wind trunk. The remedy may be to have a short wind trunk, to have a concussion bellows, or, best of all, to arrange a reservoir under the organ into which the wind from a sufficiently large bellows shall empty itself. This latter is a better mode of supplying wind than any other, and should always be adopted where it is at all practicable.

FAULTS IN ACTIONS.

Weak Rollers sometimes cause a most unpleasant touch to the manuals. When a key is pressed, the roller, not having power to pull down the pallet at once, gives slightly, and the key goes some way down without sounding the pipes, then the pallet, at last coming into action, gives to the finger an unpleasant jerking sensation. Remedy: New and stronger rollers; this would not occur if these were of iron.

If the roller arms are of iron, and have rusted, sometimes the key refuses to act at all until great pressure is added, when it goes with a jerk. This state of affairs must be altered by attending to the roller arms and their action.

Thumping Keys.—Occasionally a noise is heard when the keys are put down, caused by the insufficiency of the bushing underneath them. This is to be remedied by renewing the felt under them.

Noisy Trackers.—If the trackers of an organ are unusually long, or if they are horizontal in position, they will sometimes flap together; this will cause a most unpleasant clattering noise. The way to prevent the nuisance, is to arrange that the trackers run on rollers, or that little guides are inserted at intervals to keep them straight.

Dumb Keys.—When a key is found to remain down without producing any sound whatever, it points to some derangement of the action between it and the pallet. This may easily be traced, and may resolve itself into some matter connected with the junctures of the various parts of the movement, or the breakage of a square. In the latter case of course a new square would remedy the evil. It may be that a leather button will have slipped on the tap wire or that a tracker hook is broken. These little matters can easily be altered or mended by the organist. In screwing a button on a wire, always grease the wire and hold it with pliers *above* the button that it may not twist and break. A tracker hook can always be made with a little wire, and it is never difficult to get a new tap-wire made at a few minutes' notice by any jeweller or watchmaker, should such be required. It may be as well to say that a saddler can always punch suitable buttons if they are wanted.

Unsatisfactory Touch.—All persons who have much playing on the organ will have noticed that the touch alters considerably, according to the season of the year, and that it is much more shallow in the hot summer weather than it is in the winter. When it becomes very shallow, an insufficient amount of wind is given to the pipes, and they speak out of tune. When the touch is too deep the playing becomes laborious. As a rule, this derangement of touch can be altered in a very few minutes by regulating the screws or wedges that are placed for the purpose under each end of the backfall frame. If the instrument has not this modern arrangement it will be necessary to screw up or down each leather button of each tracker separately. This is not only a work of some trouble, but necessitates the presence of a second person at the manuals, who notes that each key is at the proper heighth and regular with its neighbours, and calls to the operator in the organ as to whether he should raise or lower any particular one. To raise a key, screw up the button; to lower a key, unscrew the button. If a single key is found displaced, and too high or too low, it is generally owing to the button having slipped. This is, of course, easily remedied.

If a key is too high it sometimes causes a ciphering to occur, by admitting a small quantity of wind to the pallet. Sometimes, too, the lowering of a key will give the same effect.

Breakage of Pedal Spring.—When this happens the weight of the key is sufficient to effect the movement and allow a little wind to pass the pallet, and sometimes, if the manual is coupled, it makes that department cipher too. This can be altered by the adjustment of a suitable spring to the offending pedal key.

Defects in Drawstop Action.—If a drawstop rod is found to come out too far, to go in too far, or to move entirely in either direction without affecting the slider, it is probably due to one of the connecting pins of this department having slipped out. It is most easily replaced, and it will only be necessary to find out where the offender lies.

Stiffness may arise from various causes. The slider may have insufficient room for its movement, and then it will be necessary to loosen the screws of the upper board. Again, in hot weather, a binding of the slider may occur from a warping. This is no trivial matter, and we would advise all amateurs to be careful how they meddle with any fault which may involve the sliders, upper boards, or table.

Apart from those specific derangements that we have given above, many little matters may occur, the correction of which would be obvious to the least experienced organist, and a great deal of what should and what should not be attempted without the aid of the tuner, must, of necessity, be left to the judgment of the persons concerned. There can be no doubt that many of the above faults can be rectified with a very small amount of technical knowledge, and may thus save a great amount of trouble and inconvenience, especially in country districts. We would suggest that every organist should devote some one hour per week to his instrument, and should then try the various actions, and put straight any little deficiency in their working. By this means errors and faults would not be allowed to accumulate, and the instrument always kept in fair order.

It is always advisable to have a book, or, where the tuner comes at frequent and regular intervals, a slate, whereon every fault, either in action, speech, or tuning, is accurately entered. By this means the tuner, when he comes, can see at once what he has to do, or at any rate the more important items that have been noticed, and thus save himself time, and be able to devote more leisure to the actual work in hand, than if he had himself to *try* all over the instrument to find out where errors may be lurking.

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CHAPTER XLI.

Blowing Engines.

AMONG the many luxuries that are known to the organist of the present day, there are none of higher value than those machines which have been brought to bear to keep up the supply of wind in the bellows. No one can have played on even a moderate sized organ without having felt how much labour he was imposing upon a fellow creature when he used the larger stops, and many a long performance has been curtailed, many a piece temporarily re-arranged, in order to give some little semblance of rest, or less hard work, to the blower or blowers.

In speaking of these machines it would hardly be fair to include in the category the ordinary steam engine. That this latter is useful for the largest organs need hardly be said, and we have already mentioned how it is employed in the blowing of the organ in the Albert Hall. The large instrument belonging to Mr. Holmes is also supplied by one of nine horse power; but for small organs in Churches, country districts, and chamber use, the steam engine is obviously out of place. Not only would it be a source of much labour in itself to keep in order, to clean, and, above all, to attend to when actually at work, but what is of greater importance, it cannot be driven without a boiler; and all persons who have had occasion to use these are aware of the trouble and continual source of anxiety that they cause; then, again, the steam engine cannot be started without more or less preparation; so that, unless a long performance is contemplated, it would never be worth while to get so complicated an auxiliary into action. Leaving these, then, as useful only for very large instruments and under exceptional circumstances, we come to a machine that can be made to do work suitable for almost any sized organ whatsoever—we alludeto the gas engine.

The best form of this machine that can be used for organ work seems to be that patented by Messrs. Crossley Brothers, Manchester. Before entering into the advantages or capabilities of this class of engine we must point out that the access to a gas supply is a *sine quâ non*. Having said thus much, we may enter into the advantages to be derived from one of the engines.

The leading characteristics that the machines have displayed are silence, easy manipulation, regular action, and great cheapness in working. The engine that has been used for this work is known as the Otto Silent Gas Engine, and is made from half-horse power up to sixteen-horse power nominal, and from the many testimonials that have been received from well-known sources, there can be no doubt whatever that, where the driving power is attainable, they are superior in many respects to any other class of motor.

The consumption of gas by these engines when in good order may be taken as 23ft. per indicated horse power, and for an average, say 1ft. more for side lights. This assumes the engine to be working up to its maximum power. The consumption of gas in practice will, however, depend upon the amount of work accomplished. It may fairly be stated that 1d. per hour per indicated horse power will be the cost of working, gas being taken at the prices sold at most large towns.

To accomplish the proper blowing of the organ, Messrs. Crossley Brothers supply a particular apparatus. The engine drives with a belt to a shaft, bearing fast and loose pulleys. This shaft drives a small crank shaft which works the feeders of the organ. The engine belt is guided by a strap fork, and to this is attached at one end a small chain with a weight, this weight being carried over the pulley just above the bellows reservoirs. These rise and come within two inches or so of the top, where they come in contact with the weight and lift it. At the other end of the strap fork another chain, with a very light weight, is attached, so that when the bellows reservoir is lifted this light weight pulls the belt on to the loose pulley, and thus the feeders are stopped. On the bellows becoming sufficiently exhausted the heavy weight is released and raises the light one up again, at the same time pulling the strap fork, and thus getting the belt once more on to the fast pulley and supplying the feeders. The action is very perfect, and works extremely well.

Mr. Willis, who has put up the organs of St. Paul's and Salisbury Cathedrals, has arranged the engines with a particular form of regulator of his own.

The starting of the engine is effected by turning the flywheel sufficiently to draw in gas to the piston, the attention required during actual working is *nil*, and oiling once a day is enough for any work that would be required for such performance as is here under consideration. About half an hour per week would be ample time to devote to the cleaning of the engine.

In calculating the cost per hour it is but fair to state that as organ blowing does not require the full power of the engine, it seldom exceeds a halfpenny for a four horse-power engine. It is better that the engine should be in a separate room or vault from the organ, and any ordinary workman can fix it.

The following list of organs at present supplied with these machines will be of interest, and we may add that we have had opinions of a most satisfactory character from some of those who have had the management of the organs.

Date.	Town.	Power.	To Whom Delivered.	Used for.
1878	Bradford	3½h.p.	St. Mark's Church, Manningham	Organ blowing
1880	Edinburgh	3½ ,,	St. Mary's Cathedral	Organ blowing
1879	London	3½ ,,	St. Paul's Cathedral	Organ blowing
1878	Salisbury	3½ ,,	Salisbury Cathedral	Organ blowing
1879	Armley	2 ,,	St. Bartholomew's Church	Organ blowing
1878	Sheffield	2 ,,	The Albert Hall Co.	In place of six men
1879	Bowdon	1 ,,	J. Sidebottom, Esq.	Organ blowing
1879	Halifax	1 ,,	W. H. Foster, Esq.	Pump & organ
1878	London	1 ,,	Royal National College for the Blind, Upper Norwood	Organ blowing
1878	London	1 ,,	M. A. Lochner, Esq., 133, Lancaster-road, Notting Hill	Organ blowing
1877	Loughboro'	,,	Sir W. H. Salt, Maplewell Hall	Organ blowing
1877	Navenby	1 ,,	R. H. C. Neville, Esq.	Pump & organ

There is yet another kind of engine used for the blowing of organs that differs essentially from the foregoing, in that it requires no gas or heat for its maintenance, but is worked by water. We refer to Joy's patent hydraulic engine. This has been found of great use where water pressure can be commanded, and for smaller organs one engine can be made to do all the work necessary to keep up a sufficient supply of wind.

For very large organs more than one engine is required, and perhaps they are not quite so suited for hard work as for such a modified kind as would be required with a two-manual organ, or a moderate sized three-manual instrument.

The one very great advantage that these have over all other mechanical contrivances for blowing organs is, that they are at once and always under the control of the player, who, by means of an ordinary stop handle, generally labelled "Wind," can start the engine at a moment's notice.

The engines are so regulated by valves that they can be adapted to almost any pressure of water that may be attainable, and although we have known occasional failures in their action, it is probable that this is more frequently to be accounted for by failure of water pressure, than by any fault in the engine itself. The engines are very easily attached to ordinary bellows handles, so that in case of accident manual labour can at once be substituted without any delay or difficulty. The cost of working them depends entirely upon the price of water on the spot.

Messrs. Forrester and Co., of Liverpool, have a patent water meter that efficiently measures the quantity of water passing through a given pipe, and not only so, but can itself be adapted to blow an organ.

Of the above engines there will be no difficulty in seeing that each will have its champions according as gas or water is the more easily attainable. In many country districts the hydraulic engine is going steadily on with its work, supplied by a local stream at no cost save the primary one necessary in the arrangements. But, again, in a town the supply of water may not only be expensive, but is often intermittent, so that in such a case a gas engine will be found the more useful. But all organists who have had to depend upon manual labour for their blowing know how exceedingly difficult it is to get an efficient man at the bellows at a moment's notice, and thus a great deal of the pleasure of playing on or showing an organ, is often damped or lost. Whereas, to be able at any moment of the day or night to go to the instrument and play, without in any way disturbing the rest or employment of an unwilling accomplice, and at the same time to be playing at a cost far below that of the worst paid blower, is a luxury that cannot be too widely appreciated.

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CHAPTER XLII.

General Résumé.

Those of our readers who have followed us through the preceding chapters will have seen that the organ is not merely a musical instrument of stereotyped construction—a mechanical contrivance to bring about the sounding of a varied assortment of pipes, but that in its more perfect forms it well deserves to be looked upon as a work of high art. If it were calculated how many hands were employed to turn out a first-rate instrument, among that really large army of artisans would be found representatives of almost all our important trades and manufactures, and their united efforts, without the further assistance of trained artists, in the shape of voicers and tuners, would be valueless.

We have traced the organ from its original condition—a few small pipes placed over a primitive wind reservoir—to its almost perfect existence, as we now see it before us. It will be a matter of interest to observe the different periods during which it developed most rapidly, and, at the same time, to notice those epochs when the art of organ building may be said to have remained in abeyance. A further point of interest arises from the fact that the perfection of the organ has been brought about in what may be termed distinct waves of effort—that is to say, that at different periods men have devoted their energies to certain results, and not to the general advancement of the instrument as a whole. Thus, omitting what may be called the childhood of the instrument, and beginning at the time when it had already attained some of its more important features, we see that, from the middle of the seventeenth century to the middle of the eighteenth, the energy and skill of builders were devoted to the perfecting of the sounds produced—in other words, to the manufacture, voicing, and tuning of the pipes. So well was this achieved, that if we calmly review the organ of the present day, and compare it with that of the time to which we allude, we cannot but admit that, good though our present work may be, and far as we have advanced in the matter of mechanism, special effects, and various adjuncts, we have made little or no progress in the condition of the principal ground-tone stops of the organ.

It was at the birth of the present century that the production of a more perfect mechanism absorbed the attention and employed the talent of men of considerable genius; and whatever may be the future of this still progressing instrument, it is impossible not to admit that to the nineteenth century is due all those great steps that have combined to place the largest organ so completely under the control of the performer, and to render playing the instrument a pleasure instead of a labour. The pneumatic-power bellows, that has borne fruit, as we have seen, not only in the touch, but in bringing the more distant portions of the organ under the immediate hand of the organist; the electric as well as the tubular transmission action, and others too numerous to mention here, are all the children of the present generation, and it may with truth be said that the interiors of our largest organs are by no means so complicated or so liable to derangement as were the small and insignificant instruments of our predecessors.

It is probable that the great question of compass is settled for good and all, and whatever changes may occur in this respect, will only add to the clavier to the right and upper portion of the scale.

The more perfect knowledge we possess of the natural laws governing sound has placed the balancing of the various stops of the organ on such a footing, that unless some startling change should affect the entire character of the instrument, there will not probably be any great alteration in this respect.

The condition of the manuals as regards shape, &c., has caused some little anxiety, but organ-builders are gradually arriving at a certain fixed plan, which allows one manual to overhang its neighbour, so that space is economised, and the player can reach his work with ease.

The pedal keys are still made after varying patterns, but they almost all radiate slightly, and in time there will probably remain little discrepancy in this department.

The internal movements governing the pallets have gradually undergone a change, which has eventually led to the introduction of iron to a very great extent—the advantages of this material have been pointed out. Mr. Henry Booth, of Otley, has invented and patented a "Steel Action," which has been adopted in the organ at Christ Church, Leeds.

It will only be necessary here to draw attention to the advance in the commutation actions, where the pneumatic button has superseded, or, at any rate, aided, the pedal movement.

With regard to the pipes of modern organs, taken as a whole, more especially in the larger instruments, it is probable that the material used at the present day will, when of the same age, compare favourably with that of the more celebrated old builders. In these days pipes have assumed, if not new shapes, at least new conditions, so that we have now much more variety in tone and in stops, and there can be no doubt whatever that in the matter of Reed work our fathers were by no means equal with us, or up to our standard either in workmanship or voicing. We would draw attention to an introduction by Messrs. Bryceson Brothers and Ellis of reeds that play upon wood, and seem likely to become popular.

The Mixtures of the present day are a matter for congratulation. They are neither so shrill or so noisy as those of our predecessors, and they are made to balance better with the other stops than was usually the case in the older organs.

The nomenclature of stops is still in a transition state, and as yet there is hardly an organ that is named according to any fixed rules; it is sincerely to be hoped that the day is not far distant when organ builders will have come to some mutual understanding on a point that cannot but affect all their works.

The temperament to which the organ is tuned is practically settled, and there is not likely to occur any further serious discussion on this point.

Up to the present the One-Manual Solo Organ has not taken that position that might have been anticipated. Perhaps this may be in some manner accounted for by its not having been pushed, some difficulty also having arisen as to its manufacture. Messrs. Hill and Son are no longer the agents for its construction. No doubt the idea is of sufficient interest to bear fruit in time, and we shall doubtless some day see an organ of this description well in the market.

An advance has been made of late years in the facility with which tuners are allowed access to the interior of organs. Only practical men are aware of the great difficulty occasionally experienced in easily reaching the pipes and mechanism of some old organs—indeed the builders never seem to have taken into account the fact that from time to time the interior should be looked over, and they arranged the parts in such a manner that it was almost impossible to rectify some slight derangement without displacing large portions of the instruments. Now, however, it is seldom that any serious difficulty arises. The Mixture sliders are often divided to cut off any ranks required, and, on the whole, the tuner has no unfair obstacles placed in his way.

"Pitch," which hitherto has been not only a bone of contention, but, to some extent, an obscure subject, has been laid bare by Mr. Henry

Ellis, who may be said to have exhausted the theme as far as Europe is concerned. I do not contemplate any serious alteration in this respect for the future.

The advantages of blowing machines are gradually making themselves felt, and the variety of their form and character places one kind or another within the reach of almost any locality. They are certainly economical, and will gradually make the blowing-man a creature of the past.

Perhaps the most dangerous ground that can be trodden by authors is the field of Prophecy, but there may be conditions which would seem to warrant my venturing to predict, more or less, the future lines of action in relation to work and invention. Lately great efforts have been made to produce the tone of the true string on keyed instruments by artificially retaining vibrations set up therein. The difficulties that met the experimentalist have been so far overcome as to point to a more than possible resolution of the problem. Already have the inventors so far succeeded in their task as to induce them to seek the protection of the Patent Laws, and it may be that no very distant day will see a new class of stops possessing a pure string tone added to our present list. That such would be eminently useful in many, if not in all, organs is hardly open to doubt.

PART III.

SPECIFICATIONS.

		Canterbury Cathedral.	York Minster. (*Screen Organ.*)	York Minster. (*Nave Organ.*)	St. Paul's Cathedral.	Durham Cathedral.
Number of Manuals		2½	4	3	4	4
Compass of ditto		GG to E *No GG sharp.*	CC to G	CC to A	CC to A	CC to A
Compass of Pedals		CCC to CC 1 *Octave*	CCC to F	CCC to F	CCC to F	CCC to F
Number of Stops.	Solo Organ	None	3	None	6	6
	Swell Organ	10	14	9	12	15
	Great Organ	11	24	11	14	15
	Choir Organ	6	9	7	11	9
	Pedal Organ	4	19	6	9	10
	Couplers	3	7	6	10	10
	Total	**34**	**76**	**39**	**62**	**65**
Composition Pedals or Pneumatic Pistons		None	10	4	20*	10
Built by		Green, Hill, &c.	Hill	Hill	Willis	Willis
Notes		Been altered at various periods.			* 4 Pedals, 16 Pistons.	

Winchester Cathedral.	Bangor Cathedral.	Bath Abbey.	Wells Cathedral.	Carlisle Cathedral.	Chester Cathedral.	Chichester Cathedral.
4	3	4	3	3	5	3
cc to G	ccc to G	cc to G	cc to G	cc to G	cc to A	cc to F
ccc to G	ccc to G	ccc to E	ccc to F	ccc to F	ccc to F	ccc to E
6	None	1	None	None	4 (12)	None
13	10	10	10	11	13	11
13	13	15	13	11	17	11
8	7	7	9	6	10	6
8	3	8	7	7	10	4
5	7	8	5	5	10	5
53	**40**	**49**	**44**	**40**	**72**	**37**
17*	5	8	14*	12	10	6
Willis	Hill	Hill	Willis	Willis	Whiteley	Hill
12 Pistons, 5 Pedals.		Tremulant to Swell.	* 10 Pneumatic Pistons, 4 Pedals.		There is an Echo Organ of 8 Stops in this instrument.	Tremulant to Swell.

		Ely Cathedral	Bristol Cathedral.	Gloucester Cathedral.	Exeter Cathedral.	Hereford Cathedral.
Number of Manuals		3	3	3	3	3
Compass of ditto		CC to F		CCC to F (*Great Organ.*)	GGG to F (*Great only.*)	CC to F
Compass of Pedals		CCC to D	CCC to F	CCC to E	CCC to F	CCC to E
Number of Stops.	Solo Organ	None	None	None	None	None
	Swell Organ	6	11	12	9	11
	Great Organ	13	12	11	13	16
	Choir Organ	7	7	5	6	7
	Pedal Organ	6	3	1	3	7
	Couplers	4	7	7	6	6
	Total	**36**	**40**	**36**	**37**	**47**
Composition Pedals or Pneumatic Pistons		6	10	4	9	6
Built by		Hill	Vowles	Harris	Speechley	Gray and Davison
Notes			Organ, by Renatus Harris, 1	Built A.D. 1670. Since been frequently added to and altered, latterly by Willis, who added a Swell Organ. Compass of Swell from CC to F. Choir GGG to F. (No GGG sharp.)	Originally built by Loosemore, 1665.	Built by Harris, 1668. Enlarged by Byfield, 1730; Lincoln, 1 90; Bishop, 18—.

LICHFIELD CATHEDRAL.	LINCOLN CATHEDRAL.	LLANDAFF CATHEDRAL.	MANCHESTER CATHEDRAL.	NORWICH CATHEDRAL.	OXFORD, CHRIST CHURCH.	PETERBOROUGH CATHEDRAL.
3	3	3	4	3	3	3
CC to F	GG to F	CC to F	CC to G	CC to F	CC to G	CC to G
CCC to E	CCC to fid. G	CCC to F	CCC to F	CCC to E	CCC to F	CC to G
None	None	None	5	None	None	None
17	9	10	17	6*	10	12
19	11	10	13	10	9	12
7	6	9	8	6	5	8
10	7	4	9	2	4	7
	4	5	9	4	5	6
60	**37**	**38**	**61**	**28**	**33**	**45**
8	5	6	10	3	6	6
Holdich	Allen	Gray and Davison	Hill	Bryceson*	Gray and Davison	Hill
			There is a small Organ by Father Smith, one manual and a few pedals, also in the Cathedral.	Tenor, C Swell. Some of the old Organ attributed to Dallam, and some to Harris. *Messrs. Bryceson made some temporary improvements, 1878.	Some of the pipes of the old organ and the case have been retained; it was one of Father Smith's.	

		RIPON CATHEDRAL.	ROCHESTER CATHEDRAL.	ST. ALBAN'S ABBEY.	ST. ASAPH'S CATHEDRAL.	ST. DAVID'S CATHEDRAL.
Number of Manuals		3	3	3	3	2
Compass of ditto		CC to A	CC to G	CC to G	GG to F*	CC to F
Compass of Pedals		CCC to F	CCC to F 2½ *Octaves.*	CCC to F	CCC to E	CCC to C
NUMBER OF STOPS.	Solo Organ	None	None	None	None	None
	Swell Organ	14	11	13	10	9
	Great Organ	13	11	13	12	12
	Choir Organ	10	7	7	6	None
	Pedal Organ	7	6	5*	2	1
	Couplers	5	8	5	4	2
	Total	**49**	**43**	**43**	**34**	**24**
Composition Pedals or Pneumatic Pistons		7	8	5	5	—
Built by		Lewis	Walker	Hill	Hill	Lincoln
NOTES			shed by Messrs. Forster and Andrews.	Tremulant to Swell. A 32ft. Pedal Stop is to be added.	* Swell CC to F.	

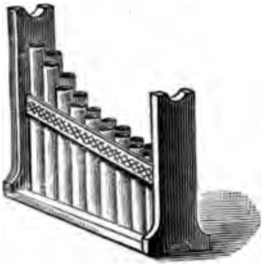
SALISBURY CATHEDRAL.	WORCESTER CATHEDRAL. *(Choir Organ.)*	WORCESTER CATHEDRAL. *(Transept Organ.)*	ALBERT HALL.	WESTMINSTER ABBEY.	TEMPLE CHURCH.	ALEXANDRA PALACE.	CRYSTAL PALACE. *(Transept Organ.)*
4	3	4	4	4	4	4	4
cc to A	cc to F	cc to A	cc to c *5 Octaves.*	ccc to F	cc to G	cc to c *5 Octaves.*	cc to A
ccc to F	ccc to c *2 Octaves.*	ccc to F	ccc to G	ccc to E	ccc to F	ccc to F	ccc to F
6	None	4	20	6	6	14	5
14	11	13	25	10	16	21	17
14	14	14	25	14	16	21	19
10	8	9	20	6	11	17	12
11	6	13	21	2	11	16	12
9	4	8*	14	5	9	15	10
64	**43**	**61**	**125**	**43**	**69**	**104**	**75**
21*	5	10	52*	3	9	41*	10*
Willis	**Hill**	**Hill**	**Willis**	**Hill**	**Forster and Andrews** *	**Willis**	**Gray and Davison**
Tremulant to Swell. * 16 Pistons, 5 Pedals to Great.	Swell compass, Tenor c to E.	* Pedal Ventie *Forte.*	Tremulant to Solo. Tremulant to Swell. Sforzando Pedal. * 32 Pneumatic Pistons, 20 Pedals.	Compass of Swell, cc to F. Compass of Choir, GG to E. Originally built by Jordan and Schreider, 1730.	Tremulant to Swell. Two pedals acting on Swell to Great, and Great to Pedals. Originally built by Father Smith, 1684. Altered by Byfield, 1740; Bishop, 1842; Robson, 1856; Schulze, 1862. *Rebuilt by Forster and Andrews, 1878.	Tremulant to Swell. Tremulant to Solo. * 32 Pneumatic pistons, 9 pedals.	Tremulant to Swell. *Ventie Pedals.

		Westminster Aquarium.	Mr. Holmes' Organ, Regent's Park.	Glasgow, Public Halls.	Edinburgh University.	Cork (R.C.) Cathedral.
Number of Manuals		3	4	4	4	3
Compass of ditto		CC to C *5 Octaves.*	CC to C *5 Octaves.*	CC to C *5 Octaves.*	CC to G	CC to A
Compass of Pedals		CCC to F	CCC to F	CCC to F	CCC to F	CCC to F
Number of Stops.	Solo Organ	None	12*	7	9	None
	Swell Organ	16	16	17	13	12
	Great Organ	17	14	18	12	12
	Choir Organ	8	12	10	10	7
	Pedal Organ	9	11	12	10	7
	Couplers	9	9	14	10	8*
	Total	**59**	**74**	**78**	**64**	**46**
Composition Pedals or Pneumatic Pistons		11	21†	13	5	7
Built by		Jones	Bryceson	Lewis	Hill	Bryceson
Notes		Tremulant to Swell. One spare slide in Great, Swell, and Pedal Organs, and two of the Couplers prepared for only.	Tremulant to Reeds of Swell and Solo Organs. Echo organ on same manual as Solo, but at other end of hall, played by electric action. From above downwards manuals are: 1, Solo and Echo; 2, Swell; 3, Choir; 4, Great. * Echo 6. † Movements various.	Tremulant to Swell, Tremulant to Choir, three Crescendo Pedals. The Great Organ is divided into two parts, 1 to 9 front, 10 to 18 back.	Tremulant to Swell.	* Worked by pedals.

LIVERPOOL, ST. GEORGE'S HALL.	BRISTOL, COLSTON HALL.	CLIFTON, VICTORIA ROOMS.	PAISLEY, N.B. TOWN HALL.	LEEDS, TOWN HALL.	CAMBRIDGE, TRINITY COLLEGE.	DONCASTER, PARISH CHURCH.	ST. MICHAEL'S CHURCH, CORNHILL.
4	4	4	3	4	4	5	3
GG to A	CC to C *5 Octaves.*	CC to G	CC to G	CC to C	CC to G	CC to A	CC to G
CCC to F	CCC to G	CCC to F	CCC to F	CCC to F	CCC to F	CCC to E	CCC to F
15	8	9	None	16*	8	17*	None
25	14	13	12	20	14	18	12
25	12	16	14	26	16	21	12
18	9	12	8	16	10	13	8
17	10	11	8	16	11	25	3
10	9	7	8	16†	9	8†	6
110	62	68	50	110	68	97	41
42*	17	9	20*	9	7	6	4
Willis	Willis (?)	Bryceson	Bryceson	Gray and Davison	Hill	Schulze	Bryceson.
Tremulant to Swell. * Pneumatic Pistons.	Tremulant to Vox Humana.	Tremulant to Swell and Solo Organs. One of the pedal registers commands a drawn action.	* 12 Pedals, 8 Pistons.	Great Organ divided into front and back. Tremulant to Swell and Solo. * Echo 7. † 7 combinations acting on Solo.	Tremulant to Swell.	* Echo 8. † By pedals.	Originally by Renatus Harris. The Electric Action is adopted in this Organ.

APPENDIX.

HISTORY.



THE annexed engraving is a facsimile of a picture in a breviary MS. of the fifteenth century—the ancestors of Jesus Christ are represented with some instruments of music, and forming a celestial concert. In the picture this instrument was being used by a king.

The following interesting passage occurs in the will of Lord John Marney, who died in 1524-25, and was buried beneath a handsome tomb, with an altar at the foot or west-end, for masses to be said for the deceased. This tomb is still perfect in Layer-Marney Church:—

"I give unto my foresaid daughter Kateryn, my grete pair of virginalls of boke fashion [book fashion], and my grete lute; also I give to my said daughter Elizabeth, the other little pair of virginalls; and the portatyves that stood in the girte [great, guard] chamber, I will shall remain within my said house to thuse [the use] of my said daughter Kateryne and so forth in manner and forme aforesaid."

Unfortunately I have not seen the original document, but I know that the above is accurate, with the exception of the modern spelling, which has been adopted where the older is of no interest from a musical point of view.

COMPASS.

The following curiosities of compass are probably unique. They were communicated to me by the Rev. Sir Frederick A. Gore Ouseley, Bart., just after the completion of the historical portion of this work.

A. Of the two organs in Seville Cathedral, one is an A compass throughout.

B. The old organ in the theatre of Oxford was built by Byfield, and was a C organ, only the CC key sounded the A below.

C. There is, or was, an organ at Tenby, the Swell of which ended below on E flat.

D. At St. Mary's, Oxford, the Swell goes down to tenor F, but the Cornopean goes to the E.

POSITION.

The east-end position of the organ spoken of at p. 33 occurred in a Church at Leominster, and also in one, if not two, in Bristol.

* * *

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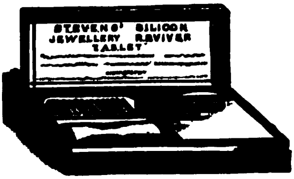

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Or PEARL DENTIFRICE is of inestimable value in preserving and beautifying the teeth, strengthening the gums, and giving a pleasant fragrance to the breath; it eradicates tartar from the teeth, prevents and arrests decay, and polishes and preserves the enamel, to which it imparts a pearl-like whiteness. Its unprecedented success for more than half a century shows the universal favor in which it is held, while the fact of its being entirely free from any acid or mineral ingredients constitutes it the safest and purest tooth powder ever used. To prevent fraud the genuine Odonto has a 3d. Government stamp on the box. Ask for Rowland's Odonto.

ROWLAND'S MACASSAR OIL

Is universally in high repute for its unprecedented success during the last 80 years in promoting the growth, restoring, improving, and beautifying the human hair. It prevents hair from falling off or turning grey, strengthens weak hair, cleanses it from scurf and dandriff, and makes it beautifully soft, pliable and glossy. For children it is especially recommended, as forming the basis of a beautiful head of hair, while its introduction into the nursery of Royalty is a sufficient proof of its merits. Sold in usual four sizes.

ROWLAND'S KALYDOR,

An Eastern botanical preparation, perfectly free from all mineral or metallic admixture. It is distinguished for its extremely bland, pnrifying, and soothing effects on the skin; while by its action on the pores and minute secretory vessels, it promotes a healthy tone, allays every tendency to inflammation, and thus effectually dissipates all redness, tan, pimples, spots, freckles, discolourations, and other cutaneous visitations. The radiant bloom it imparts to the cheek, the softness and delicacy which it induces of the hands and arms, its capability of soothing irritation, and removing cutaneous defects, render it indispensable to every toilet. Gentlemen after shaving will find it renders the skin soft, smooth, and pleasant. Of all Chemists, at 4s. 6d. Avoid cheap spurious imitations. Sold by all dealers in perfumery.

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Will travel safely to any part of the world.

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